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ILLUSTRATED CATALOGUE

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY,

AT HARVARD COLLEGE.

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No. I.

OPHIURIDÆ AND ASTROPHYTIDÆ.

BY

THEODORE LYMAN.

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THE publication of the Illustrated Catalogue of the Museum of Comparative Zoölogy has been undertaken with a threefold object. In the first place, like the catalogues of most institutions of a similar character, it is intended to make the contents of our Museum generally known, and to facilitate our exchanges. In the second place, to be the medium of publication of the novelties received at the Museum, which require to be described and illustrated by diagrams or wood-cuts, or more elaborate plates. Finally, it is hoped that it may be the basis of a systematic revision of such natural groups of the animal kingdom as are most fully represented in our collections, and that it may, as far as possible, present to the scientific world the results of the investigations carried on in the Museum with a view of ascertaining the natural limits of the Faunæ at the present time and in past ages, and the genetic relations which may exist between the order of succession of organized beings upon the earth, their mode of growth, and their metamorphoses during their embryonic life, and the plan and complication of their structure in their adult condition.

The means for publishing this work have been most liberally granted by the Legislature, at a time when, in a less enlightened assembly, the material cares of the community would have engaged their exclusive attention.

L. AGASSIZ.

CAMBRIDGE, *March* 28, 1865.

PREFACE.

THIS is a descriptive Catalogue of such Genera and Species of Ophiuridæ and Astrophytidæ, from the shores of North and South America and of Greenland, as are now represented in the Smithsonian Institution (1861) and in the Museum of Comparative Zoölogy at Harvard University (1864). To these are added notices of the other species in our Museum.

There are twenty-six genera in all, and one hundred and five species. Of these, five genera and twenty-six species are new; also, one generic name, which could not stand, has been replaced by a new one.

The Catalogue consists of a Preface, an Introduction, a List of the most important books, a Table of the known Species of Ophiuridæ and of Astrophytidæ, and descriptions of Genera and Species of the families Ophiuridæ and Astrophytidæ.

I take this opportunity to thank the following gentlemen for their kind assistance in giving me specimens, and a great variety of valuable information: Professor Henry, Secretary of the Smithsonian Institution; Professor S. F. Baird; Professor F. S. Holmes; Professor J. Leidy; Dr. J. L. LeConte; Dr. Wm. Stimpson; Professor Steenstrup and Dr. C. F. Lütken, of Copenhagen; Dr. D. F. Weinland; James M. Barnard, Esq.; Rev. J. E. Mills; Mr. T. N. Gill; Mr. Higginson; Mr. A. S. Packard, Jr.; Mr. N. S. Shaler; Professor A. E. Verrill; Mr. A. Garrett; Mr. G. A. Cheney, of Zanzibar; Mr. C. Curtis, of Key West; Dr. Whitehurst, Surgeon of the post, and Mr. Phillips, Superintendent at Fort Jefferson, Tortugas; General Geo. G. Meade, U. S. A.; General D. P. Woodbury, U. S. A.; Lieutenant Craighill, U. S. A.; Mr. A. H. Riise, of St. Thomas; Professor Valenciennes and M. Rousseau, of the Jardin des Plantes; Professor Schmarda, of Vienna; Professor Schlegel and Professor Herklots, of

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THEODORE LYMAN.

CAMBRIDGE, MASS., *October*, 1864.

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INTRODUCTION.

AS this is neither a treatise on the anatomy of serpent-stars, nor a critical essay on their classification, no parts are treated of that do not bear directly on specific and generic relations.

Without entering upon the metaphysical questions of the existence, limits, and relations of genera and of species, I have tried, as far as might be, to keep the characters strictly separate, and not to mingle generic marks in specific descriptions, or *vice versa*.

Although the names which are commonly used for the different organs by no means express their true homologies, but, on the contrary, are mostly names applied originally to anatomical parts among Vertebrata, I have nevertheless held to the received nomenclature, because any change would have to be explained by a chapter on the homologies of Radiata, which could not be here admitted.

Method of describing. — An Ophiuran, to be "in position," should be placed with the mouth down; then, horizontally towards the points of the arms, is *outwards;* horizontally towards the mouth, is *inwards;* vertically towards the back, or upper surface of the animal, is *upwards;* vertically towards the mouth and under surface of the animal, is *downwards.* It is essential that these directions should be borne in mind.

It should not be forgotten that these animals are, at different stages of growth, quite unlike in the number, size, and proportions of their parts; and that even the full-grown ones present a compound of young and of adult characters, since the outer part of the arm is made up of joints not yet fully developed. Hence it is necessary, in determining different species, that specimens of the *same size* should be compared with each other. Considering these differences, it is proper to state, that, when "arm-plates," "arm-joints," &c. are spoken of, without further qualification, in the following descriptions, it means only such as are near the base of the arm, and are therefore fully grown. Also, where the "length" or the "breadth" of a part is mentioned, the *greatest* length, or breadth, is referred to.

The millemeter is always used as the unit of measurement; there-

fore, all measurements in these descriptions may be directly compared with each other, and proportions, or tables, may be made from them.

All the species are described in the same way, and in accordance with the following table: —

1. Names.
2. Principal Synonymes, with references to their authorities. These have been taken from the original works, whenever it was possible.
3. Special Marks. A few striking characters are given, to aid the student in finding a particular species.
4. Description of a Specimen.[1] A specimen is particularly described, *as an individual*, and without reference to other individuals. Its parts are taken up in the following order: —
   - *a. General measurements.* Diameter of the disk. Distance from the outer edge of a mouth-shield[2] (Fig. 9, *a*) to the outer corner of the opposite mouth-slit.[3] Width of an arm, without its spines. Length of an arm. Distance from the outer side of a mouth-shield to the inner point of the corresponding angle of the mouth (Fig. 15, *c*), compared with the distance between the outer corners of two mouth-slits.
   - *b. Chewing apparatus.* Number, shape, size, &c. of the mouth-papillæ (Fig. 15, *d*); tooth-papillæ[4] (Fig. 5, *d'*); and teeth[5] (Fig. 5, *d''*).
   - *c. Mouth-shields*, their shape, and length to breadth; peculiarities of the madreporic shield.
   - *d. Side mouth-shields*[6] (Fig. 9, *b*), their size and shape.
   - *e. Under arm-plates*[7] (Fig. 3, *h*), their shape, size, and proportions. These plates are often octagonal, in which case the two sides that are parallel with the length of the arm are called *lateral* (Fig. 11, *h''''*); the two that run across the arm, *outer* (Fig. 11, *h''*) and *inner;* and the four sides that stand at an angle with the length of the arm, respectively *outer lateral* and *inner lateral* (Fig. 11, *h'* and *h'''*). In counting the joints, or the plates, of the arm, the innermost under arm-plate (which is often quite rudimentary) is considered as the *first*.
   - *f. Side arm-plates*[8] (Fig. 3, *i*), their form and character.
   - *g. Upper arm-plates*[9] (Fig. 2, *j*), their shape, size, and proportions. Their different sides are named in the same way as those of the under arm-plates. In some genera these plates have *supplementary pieces*, which are always placed near the edges, but vary in number, size, and shape.
   - *h. Disk*, details of its covering, above and below. The disk is divided into *brachial* and *interbrachial spaces*, the former including the sectors, which contain the arms, the latter those which are between the arms. When the scaly coat is not entirely covered by grains, or spines, there may be distinguished certain

[1] For a short anatomical description, see Lütken on Ophiurans, Silliman's Journal, XXVIII. July, 1859.

[2] Mundschild (Müll.) Scutum buccale (Müll.).

[3] Mundspalten (Müll.) Rima oris.

[4] Zahnpapillen (Müll.) Papillæ dentales.

[5] Zähne (Müll.) Dentes.

[6] Scutella adoralia.

[7] Bauchschilder (Müll.) Scutella ventralia.

[8] Scutella lateralia.

[9] Rückenschilder (Müll.) Scutella dorsalia.

principal scales, or plates; namely, *primary plates* (Pl. II. Fig. 5), which lie on the back of the disk, one in the centre, and others arranged along ten lines radiating from it; they may be distinguished by their greater size; in the young animal they cover the whole back of the disk, and are only six in number, — their number, size, shape, and position are described: — *radial shields*,[10] their size, length to breadth, shape, &c.; these are plates, arranged in five pairs, a pair over the base of each arm (Fig. 10, *l*); among Astrophytidæ they are covered with thick skin, and extend nearly to the centre of the disk, forming radiating ridges, or "ribs": — *radial scales* (Fig. 8, *m*), large scales sometimes found outside the radial shields: — *genital plates*, or *genital scales* (Fig. 4, *n*), which run along the genital slits, on the side next the interbrachial space, — their size and shape.

i. *Genital Slits* (Fig. 17, *o*).

j. *Arm-spines* (Figs. 1 and 14, *p*), their special characters and their lengths, compared with each other and with the length of the lower arm-plate. The *uppermost* spine is counted as the *first*.

k. *Tentacle-scales*[11] (Fig. 15, *q*), their number, shape, size, &c.

l. *Color.* The colors of the animal, when alive and when in alcohol.

5. Variations of the Species, in size, color, number of parts, &c.
6. Localities. In what seas found, and by whom, depth of water, habits, &c.
7. How distinguished, specifically, from other species of the same genus.
8. List of Specimens now in the collections of the Smithsonian Institution, and of the Museum of Comparative Zoölogy at Cambridge.

[10] Scutella radialia.

[11] Papillæ ambulacrales.

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LIST OF KNOWN SPECIES OF OPHIURIDÆ AND ASTROPHYTIDÆ.

NAME.	ORIGINAL NAME.	PRINCIPAL LOCALITIES.
Ophiura Lamk. (non Fbs.)		
variegata Lyman.	*Ophioderma variegata* Ltk.	West Coast of Central America.
squamosissima Lyman.	*Ophioderma squamosissima* Ltk.	West Indies.
rubicunda Lyman.	*Ophioderma rubicunda* Ltk.	West Indies; Florida.
cinerea Lyman.	*Ophioderma cinereum* Müll. & Tr.	West Indies; Florida; Gulf of Mexico.
panamensis Lyman.	*Ophioderma panamensis* Ltk.	West Coast Cent. Am.; Lower Calif.
Elaps Lyman.	*Ophioderma Elaps* Ltk.	West Indies.
brevicauda Lyman.	*Ophioderma brevicauda* Ltk.	West Indies.
guttata Lyman.	*Ophioderma guttata* Ltk.	West Indies.
olivacea Lyman.	*Ophioderma olivaceum* Ayres.	S. side Cape Cod; N. York; N. Carolina.
lævis Lyman.	*Stella lævis* Rondel.	Mediterranean.
Wahlbergii Lyman.	*Ophioderma Wahlbergii* M. & Tr.	Port Natal, South Africa.
brevispina Say.	*Ophiura brevispina* Say.	West Indies; Florida.
appressa Say.	*Ophiura appressa* Say.	West Indies; Florida.
teres Lyman.	*Ophiura teres* Lyman.	West Coast Cent. Am.; Lower Calif.
Januarii Lyman.	*Ophioderma Januarii* Ltk.	Rio Janeiro.
* *Grubii* Hell.	*Ophiura Grubii* Hell.	South Adriatic.
Holmesii Lyman.	*Ophiura Holmesii* Lyman.	Charleston, S. C.
Ophiocnemis Müll. & Trosch.		
marmorata Müll. & Tr.	*Ophiura marmorata* Lamk.	"Eastern Seas"; Ceylon.
Ophiopeza Peters.		
fallax Peters.	*Ophiopeza fallax* Peters.	Mozambique; Zanzibar.
Yoldii Ltk.	*Ophiopeza Yoldii* Ltk.	
Ophioglypha Lyman.		
lacertosa Lyman.	*Stella lacertosa* Linck.	North European Seas; Mediterranean.
albida Lyman.	*Ophiura albida* Forbes.	North European Seas; Mediterranean.
carnea Lyman.	*Ophiura carnea* Sars (MS.)	North European Seas.
Sarsii Lyman.	*Ophiura Sarsii* Ltk.	N. Europe; Greenland; N. E. America.
affinis Lyman.	*Ophiura affinis* Ltk.	North European Seas.
robusta Lyman.	*Ophiolepis robusta* Ayres.	N. Europe; Greenland; N. E. America.
nodosa Lyman.	*Ophiura nodosa* Ltk.	Greenland; Labrador; Newfoundland.
Stuwitzii Lyman.	*Ophiura Stuwitzii* Ltk.	Greenland; Newfoundland.
Lütkenii Lyman.	*Ophioglypha Lütkenii* Lyman.	Puget Sound.
Ophiocten Ltk.		
Kröyeri Ltk.	*Ophiocten Kröyeri* Ltk.	Spitzbergen; Greenland.
abyssicola Ltk.	*Ophiura abyssicola* Forbes.	Ægean Sea.
Ophiolepis Müll. & Trosch.		
annulosa Müll. & Tr.	*Ophiura annulosa* De Bl. (non Lamk.)	Timor; Celebes; New Guinea; Indian Ocean; Red Sea; Mozambique.
variegata Ltk.	*Ophiolepis variegata* Ltk.	West Coast of Central America.
paucispina Müll. & Tr.	*Ophiura paucispina* Say.	West Indies; Florida.
elegans Ltk.	*Ophiolepis elegans* Ltk.	West Indies; Florida.
cincta Müll. & Trosch.	*Ophiolepis cincta* Müll. & Tr.	Red Sea; Mozambique; East Ind. Archipelago, Vavao; New Guinea.
Garretti Lyman.	*Ophiolepis Garretti* Lyman.	Kingsmills Islands.
* *stenura* Lor.	*Ophiolepis stenura* Lor.	Quarnero.
* *atacamensis* Phil.	*Ophiolepis atacamensis* Phil.	Isla Blanca, Chili.
Ophioceramis Lyman.		
Januarii Lyman.	*Ophiolepis Januarii* Ltk.	Rio Janeiro.

* Species marked thus * have not been revised by Mr. Lyman; they have been added since his absence.

Ophiozona Lyman.

impressa Lyman.	*Ophiolepis impressa* Ltk.	West Indies; Florida.
pacifica Lyman.	*Ophiolepis pacifica* Ltk.	West Coast of Central America.

Ophioplocus Lyman.

imbricatus Lyman.	*Ophiolepis imbricata* M. & Tr.	Kingsmills Islands; Mauritius; Mozambique; Nicobar Islands.

Ophiocoma Agass.

scolopendrina Agass.	*Ophiura scolopendrina* Lamk.	New Guinea; Zanzibar; Isle de France; Kingsmills Islands; Red Sea; Indian Ocean; Nicobar Isls.; Loo Choo Isls.
erinaceus Müll. & Tr.	*Ophiocoma erinaceus* M. & Tr.	Sandwich Islands; Kingsmills Islands; Indian Ocean; Red Sea; Zanzibar.
Wendtii Müll. & Tr.	*Ophiocoma Wendtii* Müll. & Tr.	South Sea.
Schoenleinii M. & Tr.	*Ophiocoma Schoenleinii* M. & Tr.	Celebes.
Nilssonii Müll. & Tr.	*Ophiocoma Nilssonii* Müll. & Tr.	North Sea.
nigra Müll. & Trosch.	*Asterias nigra* O. F. Müll.	North European Seas.
tumida Müll. & Tr.	*Ophiocoma tumida* Müll. & Tr.	Gulf of Genoa; Norway.
pica Müll. & Trosch.	*Ophiocoma pica* Müll. & Tr.	Sandwich Isls.; Kingsmills Islands; Red Sea; Zanzibar; Mauritius; Java.
Valenciæ Müll. & Tr.	*Ophiocoma Valenciæ* M. & Tr.	Red Sea; Mozambique.
squamata Müll. & Tr.	*Ophiura squamata* Lamk. (non Delle Ch.)	Atlantic Ocean.
picta Müll. & Tr.	*Ophiura picta* Kuhl. & v. Has. (MS.)	Java.
echinata Agass.	*Ophiura echinata* Lamk.	West Indies; Florida.
brevipes Peters.	*Ophiocoma brevipes* Peters.	Mozambique.
pumila Ltk.	*Ophiocoma pumila* Ltk.	West Indies; Florida.
Riisei Ltk.	*Ophiocoma Riisei* Ltk.	West Indies; Florida.
æthiops Ltk.	*Ophiocoma æthiops* Ltk.	W. Coast Central Amer.; Lower Calif.
insularia Lyman.	*Ophiocoma insularia* Lyman.	Sandwich Islands.
Alexandri Lyman.	*Ophiocoma Alexandri* Lyman.	W. Coast Central Amer.; Lower Calif.

Ophiarachna Müll. & Trosch.

incrassata Müll. & Tr.	*Ophiura incrassata* Lamk.	Java.
infernalis Müll. & Tr.	*Ophiarachna infernalis* M. & T.	Indian Ocean.
gorgonia Müll. & Tr.	*Ophiarachna gorgonia* M. & T.	Mozambique.
septemspinosa M. & Tr.	*Ophiura septemspinosa* Kuhl. & v. Has. (MS.)	Molucca Islands.
vestita Lyman.	*Pectinura vestita* Forbes.	Ægean Sea.
* ?	*Pectinura Forbesii* Hell.	South Adriatic.

Ophiomastix Müll. & Trosch.

annulosa Müll. & Tr.	*Ophiura annulosa* Lmk. (n. De Bl.)	Java.
venosa Peters.	*Ophiomastix venosa* Peters.	Mozambique.

Ophiarthrum Peters.

elegans Peters.	*Ophiarthrum elegans* Peters.	Mozambique.

Ophioblenna Ltk.

antillensis Ltk.	*Ophioblenna antillensis* Ltk.	West Indies.

Ophiacantha Müll. & Trosch.

spinulosa Müll. & T.	*Ophiacantha spinulosa* Mül. & Tr.	N. Europe; Arctic Oc.; N. E. America.
setosa Müll. & Trosch.	*Asterias setosa* Retz.	Sicily.
scabra Sars.	*Ophiacantha scabra* Sars.	Mediterranean.

Ophiopholis Müll. & Trosch.

bellis Lyman.	STELLA SCOLOPENDROIDES; *bellis scolopendrica* Linck.	Northern Europe; Arctic Sea; N. E. America.

Ophiopholis Müll. & Trosch. (*continued*).

Kennerlyi Lyman.	*Ophiopholis Kennerlyi* Lyman.	Puget Sound; Mendocino, Cal.
Caryi Lyman.	*Ophiopholis Caryi* Lyman.	San Francisco, Cal.

Ophiostigma Ltk.

isocanthum Lyman.	*Ophiura isocantha* Say.	West Indies; Florida.
tenue Ltk.	*Ophiostigma tenue* Ltk.	West Coast of Central America.

Ophiactis Ltk.

asperula Ltk.	*Ophiolepis asperula* Phil.	Chili.
Kröyeri Ltk.	*Ophiactis Kröyeri* Ltk.	West Coast of Central America.
Örstedii Ltk.	*Ophiactis Orstedii* Ltk.	West Coast of Central America.
virescens Örst. & Ltk.	*Ophiactis virescens* Örsted. & Ltk.	W. Coast Cent. America; Lower Calif.
arenosa Ltk.	*Ophiactis arenosa* Ltk.	West Coast of Central America.
Reinhardtii Ltk.	*Ophiactis Reinhardtii* Ltk.	Nicobar Islands.
Krebsii Ltk.	*Ophiactis Krebsii* Ltk.	West Indies; Florida; S. Carolina.
Mülleri Ltk.	*Ophiactis Mülleri* Ltk.	West Indies; Florida.
sexradia Ltk.	*Ophiolepis sexradia* Grube.	Sandwich Islands.
simplex Ltk.	*Ophiolepis simplex* Le Conte.	West Coast of Central America.
Ballii Sars.	*Ophiocoma Ballii* Thompson.	English Coast; Bergen.
virens Sars.	*Ophiolepis* (*Ophiactis*) *virens* Sars.	Mediterranean.

Amphiura Forbes.

filiformis Forbes.	*Asterias filiformis* O. F. Müller.	North European Seas.
Holbolli Ltk.	*Amphiura Holbolli* Ltk.	Arctic Sea; Greenland; Spitzbergen.
Chiajii Forbes.	*Amphiura Chiajii* Forbes.	North European Seas; Mediterranean.
Puntarenæ Ltk.	*Amphiura Puntarenæ* Ltk.	West Coast of Central America.
microdiscus Ltk.	*Amphiura microdiscus* Ltk.	West Coast of Central America.
violacea Ltk.	*Amphiura violacea* Ltk.	West Coast of Central America.
Örstedii Ltk.	*Amphiura Örstedii* Ltk.	West Coast of Central America.
Riisei Ltk.	*Amphiura cordifera* Ltk.	West Indies.
Stimpsonii Ltk.	*Amphiura Stimpsonii* Ltk.	West Indies.
tenera Ltk.	*Amphiura tenera* Ltk.	West Indies; South Carolina.
geminata Ltk.	*Ophiolepis geminata* Le Conte.	West Coast of Central America.
gracillima Ltk.	*Ophiolepis gracillima* Stimpson.	South Carolina.
atra Ltk.	*Ophiolepis atra* Stimpson.	South Carolina.
perplexa Lyman.	*Ophiolepis perplexa* Stimpson.	Port Jackson, Australia.
florifera Forbes.	*Amphiura florifera* Forbes.	Ægean Sea.
squamata Sars.	*Asterias squamata* Del. Chiaje.	Grand Manan, Massachusetts Bay; Mediterranean; England; Denmark.
urtica Lyman.	*Amphiura urtica* Lyman.	Puget Sound.
pugetana Lyman.	*Amphiura pugetana* Lyman.	Puget Sound; Mendocino, Cal.
occidentalis Lyman.	*Amphiura occidentalis* Lyman.	Monterey; Mendocino; Puget Sound.
punctata Ltk.	*Ophiocoma punctata* Forbes.	English Coast.
limbata Ltk.	*Ophiolepis limbata* Grube.	Rio Janeiro.
chilensis Ltk.	*Ophiolepis chilensis* Müll. & Tr.	Chili.
Goodsiri.	*Ophiocoma Goodsiri* Forbes.	English Coast.

Ophiophragmus Lyman.

marginatus Lyman.	*Amphiura marginata* Örst. & Ltk.	West Coast of Central America.
septus Lyman.	*Amphiura septa* Ltk.	West Indies.
Wurdemani Lyman.	*Amphiura Wurdemani* Lyman.	West Coast Florida.

Ophiocnida Lyman.

brachiata Lyman.	*Asterias brachiata* Montagu.	English Coast.
scabriuscula Lyman.	*Amphiura scabriuscula* Ltk.	West Indies.
hispida Lyman.	*Ophiolepis hispida* Le Conte.	West Coast of Central America.
neapolitana Lyman.	*Amphiura neapolitana* Sars.	Mediterranean.
Ballii Lyman.	*Amphiura Ballii* Sars.	Norway.
abyssicola Lyman.	*Amphiura abyssicola* Sars.	Norway.

Hemipholis Agass. (MS.)

cordifera Lyman.	*Asterias cordifera* Bose.	South Carolina.

Ophionereis Ltk.

dubia Lyman.	*Ophiolepis dubia* M. & T. (Savig.)	Red Sea.
reticulata Ltk.	*Ophiura reticulata* Say.	West Indies; Florida.
annulata Lyman.	*Ophiolepis annulata* Le Conte.	West Coast of Central America.
Schayeri Ltk.	*Ophiolepis Schayeri* Müll. & Tr.	Van Diemen's Land.
Xantusii Lyman.	*Ophionereis Xantusii* Lyman.	Lower California.
porrecta Lyman.	*Ophionereis porrecta* Lyman.	Florida.

Ophiopeltis Düben & Koren.

securigera Düb. & Kor.	*Ophiopeltis securigera* Düb. & K.	Baltic Sea.

Ophiopsila Forbes.

aranea Forbes.	*Ophiopsila aranea* Forbes.	Mediterranean.
annulosa Ltk.	*Ophianoplus annulosus* Sars.	Mediterranean.
Riisei Ltk.	*Ophiopsila Riisei* Ltk.	West Indies; Florida.

Ophiothrix Müll. & Trosch.

spiculata Le Conte.	*Ophiothrix spiculata* Le Conte.	West Coast of Central America.
rosula Forbes.	STELLA SCOLOPENDROIDES; *rosula scolopendroides* Linck.	Mediterranean; N. European Seas.
hirsuta Müll. & Tr.	*Ophiothrix hirsuta* Müll. & Tr.	Red Sea.
comata Müll. & Tr.	*Ophiothrix comata* Müll. & Tr.	
longipeda Müll. & Tr.	*Ophiura longipeda* Lamk.	Society Islands; Timor; Nicobar Islands; Isle de France.
Rammelsbergii M. & T.	*Ophiothrix Rammelsbergii* M. & T.	
fumaria Müll. & Tr.	*Ophiothrix fumaria* Müll. & Tr.	
triglochis Müll. & Tr.	*Ophiothrix triglochis* Müll. & Tr.	Port Natal, South Africa.
ciliaris Müll. & Tr.	*Ophiothrix ciliaris* Müll. & Tr.	
aspidota Müll. & Tr.	*Ophiothrix aspidota* Müll. & Tr.	East Indies.
nereidina Müll. & Tr.	*Ophiura nereidina* Lamk.	South Sea.
violacea Müll. & Tr.	*Ophiothrix violacea* Müll. & Tr.	West Indies; Rio Janeiro.
spongicola Stimpson.	*Ophiothrix spongicola* Stimpson.	Port Jackson, Australia.
planulata Stimpson.	*Ophiothrix planulata* Stimpson.	Groper Shoal, S. lat. 20°, E. lon. 160½.
Örstedii Ltk.	*Ophiothrix Örstedii* Ltk.	West Indies; Florida.
Suensonii Ltk.	*Ophiothrix Suensonii* Ltk.	West Indies; Gulf of Mexico.
lineata Lyman.	*Ophiothrix lineata* Lyman.	Florida.
angulata Ayres.	*Ophiura angulata* Say.	South Carolina; Georgia.
alba Grube.	*Ophiothrix alba* Grube.	Atlantic Ocean.
magnifica Lyman.	*Ophiothrix magnifica* Lyman.	Chili.
dumosa Lyman.	*Ophiothrix dumosa* Lyman.	Gulf of California.
parasita Müll. & Tr.	*Ophiothrix parasita* Müll. & Tr.	Australia.
virgata Lyman.	*Ophiothrix virgata* Lyman.	Kingsmills Islands.
propinqua Lyman.	*Ophiothrix propinqua* Lyman.	Kingsmills Islands.
Cheneyi Lyman.	*Ophiothrix Cheneyi* Lyman.	Zanzibar.
demessa Lyman.	*Ophiothrix demessa* Lyman.	Kingsmills Islands; Sandwich Islands.

Ophiomyxa Müll. & Trosch.

pentagona Müll. & Tr.	*Ophiura pentagona* Lamk.	Mediterranean.
flaccida Ltk.	*Ophiura flaccida* Say.	West Indies; Florida.

Ophioscolex Müll. & Trosch.

glacialis Müll. & Tr.	*Ophioscolex glacialis* Müll. & Tr.	Spitzbergen.

Asteronyx Müll. & Trosch.

Loveni Müll. & Trosch.	*Asteronyx Loveni* Müll. & Tr.	Norway.

Trichaster Agass.		
palmiferus Agass.	*Euryale palmiferum* Lamk.	India.
Astrophyton Linck.		
arborescens Müll. & Tr.	*Stella arborescens* Rondel.	Mediterranean.
Lamarckii Müll. & Tr.	*Astrophyton Lamarckii* M. & Tr.	North European Seas.
eucnemis Müll. & Tr.	*Astrophyton eucnemis* M. & Tr.	Greenland.
Caryi Lyman.	*Astrophyton Caryi* Lyman.	San Francisco, Cal.
Agassizii Stimpson.	*Astrophyton Agassizii* Stimps.	Cape Cod, Ms., to Gulf St. Lawrence.
Linckii Müll. & Tr.	*Astrophyton Linckii* Müll. & Tr.	North European Seas.
clavatum Lyman.	*Astrophyton clavatum* Lyman.	Zanzibar.
costosum Seba.	*Astrophyton costosum* Seb. (n.Ltk.)	Florida; West Indies.
cœcilia Ltk.	*Astrophyton cœcilia* Ltk.	West Indies.
Krebsii Ltk.	*Astrophyton Krebsii* Ltk.	West Indies.
chilense Phil.	*Astrophyton chilense* Phil.	Chili.
verrucosum Müll. & Tr.	*Euryale verrucosum* Lamk.	Indian Ocean.
asperum Agass.	*Euryale asperum* Lamk.	India.
exiguum Agass.	*Euryale exiguum* Lamk.	South Sea.
Asteroporpa Örsted.		
annulata Örst. & Ltk.	*Asteroporpa annulata* Örst. & Ltk.	West Indies.
affinis Ltk.	*Asteroporpa affinis* Ltk.	West Indies.
* *dasycladia* Duj. & H.	*Trichaster dasycladia* Val. MS.	Guadaloupe.
Asterochema Örsted.		
oligactes Ltk.	*Asterias oligactes* Pallas.	West Indies.

DOUBTFUL SPECIES.

Ophiura cuspidifera Lamk.
Astrophyton costosum, costis conicis Linck.
Astrophyton scutatum, scuto striato Linck.
Astrophyton scutatum, scuto rotato Linck.

Stella scolopendroides granulata Linck.	*Ophiocoma erinaceus?*	*Ophiocoma echinata?*
Erste Sternfisch F. Martens.	*Ophiopholis?*	
Ander Sternfisch F. Martens.	*Astrophyton?*	

GEOGRAPHICAL DISTRIBUTION.

Despite the great additions to our knowledge of the two families of serpent-stars, we are scarcely yet in a position to do more than hint at the faunal distribution of the species. There is, so to speak, a fauna of the North Atlantic, whereof the extreme limits are from the Mediterranean, on the east, to Cape Cod, on the west. The *Amphiura squamata* is found over this whole range; and even of *Ophiopholis bellis* I have seen a specimen from Fayal. This last species swarms in all the northern part of this faunal region, from east to west; *Ophioglypha robusta*, *O. Sarsii*, and *O. nodosa* are common to the two sides of the Atlantic, as well as *Ophiocantha spinulosa;* while *Ophiothrix rosula*,

though ranging from the Mediterranean to the Arctic seas, does not pass to the western side. *Astrophyton Agassizii*, on the other hand, is a purely American species. So that the two sides of this region, though agreeing in many things, are distinguished in others. Thus, the genera *Ophiothrix* and *Ophiocoma* are quite wanting along the northeastern shores of America. After passing Cape Cod, we find, to the south, the genus *Ophiura*, but only one species, the northern species of various genera disappearing, and a barren tract succeeds as far as North Carolina, in which space I know of but one Ophiuran, *Ophiura olivacea*, as a common resident. Once in the latitude of Charleston, South Carolina, we meet a rich store of species, and encounter the genera *Amphiura*, *Hemipholis*, and *Ophiothrix* in abundance; not, however, the same species that occur in the Gulf of Mexico and among the Antilles, in which narrow circle lives a distinct fauna, of surpassing richness; — there may be seen the myriads of *Ophiothrix Örstedii*, *Ophiocoma echinata*, *Ophiura appressa*, and *Ophiopsila Riisei;* while in the deeper waters we have the curious forms of *Asterochema* and *Asteroporpa*. The development of the genus *Ophiura* is especially remarkable, and quite characteristic. Passing the narrow isthmus, to the Pacific coast of Central America, we light upon a distinct fauna again, but one which is a counterpart of that of the Gulf. The same forms of *Ophiothrix*, *Ophiocoma*, *Ophionereis*, and *Ophiura*. Following this coast to the north, we in due time arrive at a temperate fauna, in the region of Northern California. There, again, is a *souvenir* of the eastern coast; the characteristic *Ophiopholis*, the *Amphiura pugetana*, and even an *Astrophyton*, which recalls *A. eucnemis*. Striking now westward, and getting to the Sandwich Islands, we are on the borders of what may be termed the fauna of the great ocean, a fauna presenting in its vast range the greatest contrast to that of the Gulf of Mexico. This region extends from the Red Sea and Zanzibar, on the west, to the Sandwich Islands, on the east; and from the Kingsmills group, on the south, to the Loo-Choo Islands, on the north! New forms here surprise us; *Ophiopeza* replacing *Ophiura*, which is unknown; then *Ophiarachna*, *Ophiomastix*, and *Ophiarthrum;* while, on the other hand, the already familiar *Ophiocoma* and *Ophiothrix* are abundant, though with new features, as in *Ophiothrix longipeda*, or in *Ophiocoma pica*. *Amphiura* is almost wanting, but one *Ophionereis* occurs.

As to the faunæ of South Africa, Australia, and Southern South America, it is not well to speak, lest grave errors occur, from want of precise knowledge. I will merely mention that I saw in the collection of Professor Schmarda an *Ophioglypha* from New South Wales, — a very interesting hint on the correspondence of this fauna with the northern one.

DESCRIPTION OF GENERA AND SPECIES.

OPHIURA Lamk. (*non* Forbes).

Type of the Genus, *O. lævis.*

Ophiura Lamk. Syst. des Anim. sans Vertèb. 1801.
Ophioderma Müll. and Trosch. Syst. Asterid. 1842.

Disk granulated; teeth and mouth-papillæ; no tooth-papillæ; spines essentially smooth, shorter than the joints, flattened, numerous (7 to 13), arranged along the outer edge of the side arm-plates; two tentacle-scales, the outside one covering the base of the lowest arm-spine; no ray-scales; an indentation in the back of the disk, where it is joined by the arm; four genital slits, the first pair beginning outside the mouth-shields.

GROUPING OF SPECIES HEREIN DESCRIBED.

- Arm-spines equal,
  - Side mouth-shields covered, — *O. brevicauda.*
  - Side mouth-shields naked,
    - *O. brevispina.*
    - *O. Holmesii.*
    - *O. olivacea.*
    - *O. Januarii.*
- Lowest arm-spines longest,
  - With radial shields,
    - *O. lævis.*
    - *O. cinerea.*
    - *O. rubicunda.*
    - *O. panamensis.*
    - *O. teres.**
  - Without radial shields, — *O. appressa.*

Ophiura brevicauda Lyman.

Ophioderma brevicauda Lütken; Vidensk. Meddelelser. Jan., 1856.
Ophioderma brevicauda Lütken; Addit. ad Hist. Oph. 94.

Special Marks.—Granulation very coarse; arm-spines unusually short and stout; arms generally not more than three or three and a half times the diameter of disk.

Description of a Specimen.—Diameter of disk, $20^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $7^{mm.}$; width of arm, without spines, $3.8^{mm.}$; length of arm, $77^{mm.}$; the distance from outer side of mouth-shield to inner points of teeth is to that between outer corners of mouth-slits as 3 : 4.2; mouth-papillæ, eighteen; outer

* The largest specimens have the radial shields often covered.

one irregular in shape, longer than others; pointed; second one larger than those beyond, irregular, flattened; two innermost ones stout, conical; the rest fine, sharp, spine-like; teeth, five; lowest one sharp, conical; second and third flat, tapering; fourth flat, with nearly a square shape; uppermost one like second and third; mouth-shields triangular heart-shaped, point inward, inner sides a little re-enteringly curved, corners strongly rounded, length to breadth, 1.9 : 2.2; side mouth-shields, and space between mouth-shields and mouth-papillæ, covered by loose granulation; under arm-plates overlapping, about as long as broad; small compared with the width of arm; outer side curved, laterals re-enteringly curved, inner laterals short and a little sloping, inner side shorter than outer, and nearly straight; length to breadth (twelfth plate), 1.2 : 1.2. First plate has a lobed outer side, in consequence of two pores lying between it and second plates; plates just within margin of disk are, as usual, rather broader than those just beyond. The proportions of the twelfth plate are continued in those beyond, till near the end of the arm; the plates, however, grow more shield-shaped, and proportionately longer. Side arm-plates encroaching a little between both upper and under plates; upper arm-plates broader than long, thickened, somewhat irregular, sometimes broken, bounded without and within by more or less wavy lines; outer corners strongly rounded; inner side shorter than outer; length to breadth (seventh plate), 1.4 : 3.4; two thirds out on arm, same general shape; length to breadth, .9 : 1.8. First four plates enclosed by scaly prolongations of disk, and accordingly modified in shape; first plate quite rudimentary; disk entirely covered, except a few scales at base of arms, with comparatively coarse granulation, about thirty-six grains to a square *mm.*; arm-spines, nine, of nearly equal length, unusually short, stout, and thick; length near base of arm to length of under arm-plate, .7 : 1.2; the spines are pointed, and but little flattened; tentacle-scales; inside one long, oval; length to that of under arm-plate, .7 : 1.2; outside one shorter, broader, and cut off at its end; color, in alcohol; above, light yellowish-brown, disk finely speckled with dull sap-green, arms irregularly blotched and banded with the same; below, ground-color same as above, but lighter, on arms and mouth-shields some traces of green.

Variations. — This species seems to fade in alcohol. It is then sometimes quite white; but dry specimens preserve the colors, more or less. These are various tints of sap-green, lake-red, and rusty-brown, much blended, and irregularly disposed. A common pattern is a brown disk above, greenish round the edges, upper surface of arms variously banded, spotted, and mottled, with many shades of green and red; interbrachial spaces, below, greenish brown, speckled with red, a red spot on each mouth-shield; under surface of arms similar to upper surface, but more

uniform and lighter. The length of the arms seems to average not more than three or three and a half times the diameter of the disk; thus, 20 : 63, 17 : 53, 16 : 45, 9 : 32. A specimen having a disk of 9$^{mm.}$ agreed entirely with the largest ones, except that the mouth-shields and arm-plates were a little less angular, and there were only eight arm-spines. Very often some of the naked scales at the base of the arms become so developed as to look like little thickened plates.

This species may be distinguished from other Ophiuræ with equal spines as follows: — *O. guttata* has the upper arm-plates divided in many little pieces, and has arm-spines of a different shape; *O. brevispina* has long oval mouth-shields, and the arm-spines much less stout; *O. Januarii* has only eight arm-spines, which are long and slender; *O. variegata* has longer arm-spines, and mouth-shields longer than broad.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
97	. .	1	Tortugas, Fla.	Feb. 1856.	T. Lyman.	Alcoholic.
98	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
99	52	2	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
			Smithsonian Institution.			
1078	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1081	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1107	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1151	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiura brevispina Say.

Ophiura brevispina Say. Journ. Phil. Acad. V. 149. 1825.
Ophioderma serpens Lütken. Addit. ad Hist. Oph. 96.

Special Marks. — Color usually greenish, sometimes tinged with reddish; sides of disk generally concave; diameter of disk about 12$^{mm.}$; side mouth-shields naked; mouth-shields long heart-shaped.

Description of a Specimen. — Diameter of disk, 10.8$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 4.6$^{mm.}$; greatest width of arm, without spine, 2.5$^{mm.}$; length of arm, 42.4$^{mm.}$; distance from outer edge of mouth-shield to inner point of tooth-papillæ to that between outer corners of mouth-slits, as 2 : 2.2; mouth-papillæ, usually sixteen to each angle of mouth; outermost one small, and often partly concealed; innermost ones pointing nearly to centre of mouth, spearhead-shaped, and longer and broader than the rest; teeth, five, shaped like a flat, blunt, spearhead; lowest one smallest; mouth-

shields long heart-shaped, the point inward; length to breadth, 1.4 : 1.2; madreporic shield wider, with an uneven surface; side mouth-shields, connecting first under arm-plate with mouth-shield, irregular, lengthened, triangular, swelled; under arm-plates hexagonal, with corners somewhat rounded; outer side of each plate overlapping inner side of its successor; first plate somewhat oval, with two notches in its outer side, where two pores enter, between it and the second plate; length to breadth, 6 : 12; second plate, outer side curved, lateral sides re-enteringly curved to receive tentacle-scales, inner side a little re-enteringly curved, with a small tongue running inwards under first plate; the third plate, and those just beyond, have a similar shape, but the outer curve may be broken up into three straight lines, of which one is the outer side proper, and the other two are the outer laterals; the inner side is bounded by two inner laterals, which start from tentacle pores and disappear under preceding plate; farther out, lateral sides become straighter, and outer side is a simple curve; near tip of arm, plates do not overlap, lateral sides are short and straight, while inner laterals are very long and gradually approach each other, to meet on the middle line of the arm; lengths to breadths as follows: second plate, 1 : 1; third plate, .8 : 1; tenth plate, .8 : 1; about two thirds out on arm, .6 : .4; close to tip of arm, .4 : .3. Side arm-plates do not meet above or below, even at tip of arm; the outer edge of each is on a line with the middle of an under arm-plate; above, they overlap the inner corners of upper arm-plates a little; upper arm-plates much broader than long; outer and inner sides nearly straight; lateral sides, being partly overlapped by side arm-plates, seem to slope from without inwards; third plate with outer and inner sides nearly straight; lateral sides sloping inwards; corners rounded; length, .8$^{mm.}$; outer side, 1.8$^{mm.}$; inner side, 1.4$^{mm.}$; this is the typical shape of most of the upper arm-plates; fifteenth plate, length to breadth, .8 : 1.6; outer side curved; fortieth plate, length to breadth, .6 : 1.2; close to tip of arm, plates long heart-shaped, the point inward, length to breadth, .4 : .4; disk, above and below, together with spaces between mouth-shields and tooth-papillæ, evenly and closely covered with grains, about 260 to a square *mm.* Genital slits bounded by granulation of disk; between outer ones and side of arm may be seen grains and the edges of some scales. Arm-spines somewhat flattened, of nearly equal length, points rounded, length to that of under arm-plates, .6 : .8; sixth joint, five spines; seventh joint, six spines; eighth, ninth, and tenth joints, eight spines; eleventh joint, seven spines; about two thirds out on arm, six spines; close to tip of arm, three spines, shorter than joints, and more rounded than at base of arm. Tentacle-scales flat, with rounded ends, the one next to under arm-plate the larger; there are two to each tentacle, almost to the tip

of the arm; length near base of arm, inside scale, .4, outside scale, .2. Color, in alcohol; disk, above, greenish gray (gamboge and neutral tint), clouded with lighter; upper side of arms very irregularly barred with several shades of greenish gray, and with dirty white; edges of upper arm-plates interrupted by very fine longitudinal streaks of darker, giving the appearance of teeth; edges of disk, below, same as above, its central portion, together with mouth apparatus, under surface of arms, and arm-spines, dirty white.

Variations. — This is a pretty uniform species. Its color is usually made up of several shades of sap-green, or of greenish gray, variegated with dirty white or yellow, the under parts being much lighter and less marked. Sometimes the green is replaced by lake-red. In specimens not yet fully grown, the upper arm-spine is often shorter than the others.

Ophiura brevispina differs from other equal-spined Ophiuræ as follows: from *O. brevicauda*, in longer and flatter spines and naked side mouth-shields; from *O. olivacea*, in more octagonal under arm-plates; from *O. guttata*, in having unbroken upper arm-plates; from *O. Januarii* and *O. variegata*, in shorter and differently-shaped arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
89	. .	12	Cape Florida.	Apr. 1858.	G. Wurdeman and J. E. Mills.	Alcoholic.
90	. .	1	Tortugas, Fla.	Mar. 1, 1858.	G. Wurdeman and J. E. Mills.	"
91	. .	2	Cape Florida.	Feb. 1856.	T. Lyman.	"
92	. .	3	Florida.	. . . . .	Prof. Agassiz.	"
93	. .	2	Florida.	. . . . .	G. Wurdeman.	"
94	. .	11	Cape Florida.	Apr. 1858.	G. Wurdeman and J. E. Mills.	"
95	. .	2	West Indies.	. . . . .	University Museum, Copenhagen.	"
96	. .	1	Cape Florida.	. . . . .	G. Wurdeman.	Dried.
			Smithsonian Institution.			
1065	. .	4	Florida.	. . . . .	. . . . .	Alcoholic.
1059	. .	7	Cape Florida.	. . . . .	G. Wurdeman.	"
989	. .	1	Cape Florida.	1851.	. . . . .	"
1086	. .	2	St. Thomas & Bahamas.	. . . . .	A. H. Riise.	"
1108	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophiura Holmesii Lyman. (Pl. I., Fig. 7.)

Ophioderma variegatum Agass. MS.
Ophiura Holmesii Lyman; Proceed. Boston Soc. Nat. Hist., VII. p. 255. 1860.

Special Marks. — Disk thick; arms stout, stiff; in length less than four times diameter of disk. Color, various patterns of white, and of different shades of green. No naked scales at base of arms.

Description of an Individual. — Diameter of disk, 19.2$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slits, 7.4$^{mm.}$; greatest width of arm without spines, 4.4$^{mm.}$; length of arm, about 74$^{mm.}$; distance from outer edge of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2.8 : 4.2$^{mm.}$. Mouth-papillæ small, stout, rounded, pointed; from 16 to 18; outermost one somewhat longer than rest; one next to outermost, broad and flattened; two innermost pointing to centre, and somewhat longer than those near them. Teeth, four in number; uppermost one longer than others, flat, and sharp-pointed; three lower ones thin, flat, and with a rounded, cutting edge. Mouth-shields long heart-shaped, with point inward; on outer edge a slight indentation; length to breadth, 1.8 : 1.6$^{mm.}$; madreporic shield shorter and broader, and with a small depression near outer edge. Side mouth-shields small, rounded, thickened, varying somewhat in shape, but commonly short, rounded, triangular; length to breadth, 1.2 : 1$^{mm.}$; length to that of mouth-shields, 1.2 : 1.8^{mm}. Under arm-plates squarish; outer side curved, laterals a little re-enteringly curved, inner side and inner laterals short, of about equal length, and lying almost in one line; farther out on arm, inner laterals and inner side are very decidedly inclined to each other, and the curve of outer side is broken up into an outer side and two outer laterals, so that here the plates have the form of a nearly regular octagon; between first and second plates, and second and third plates, a pair of pores, separated by a little tooth. First plate very irregular oval, with a notch on its inner side; length to breadth, .8 : 1.4$^{mm.}$. Second plate with a curved outer side, lateral and inner sides re-enteringly curved, the latter most so; length to breadth, 1 : 1.4$^{mm.}$. Third plate, outer and inner sides curved, the latter the less; lateral sides re-enteringly curved; length to breadth, 1.2 : 1.6$^{mm.}$. Fifth plate, same as third; about one third out on arm, plates octagonal, length to breadth, 1.2 : 1.4; near point of arm heart-shaped, with point inward. Side arm-plates compactly soldered with surrounding parts, stout, a little overlapped by upper plates, their outer edges showing plainly, by reason of shortness of arm-spines; they continue till quite near end of arm without meeting either above or below. Upper arm-plates much broader than long, outer corners rounded, inner

side a trifle shorter than outer side; incision in disk includes three plates; first plate rudimentary, in form of segment of a circle, with its curve inward, length to breadth, .8 : 1.2$^{mm.}$; second plate similar in form, length to breadth, .8 : 1.8$^{mm.}$; third plate similar in form, length to breadth, 1 : 3$^{mm.}$; fourth plate of normal form, length to breadth, 1.2 : 3.2$^{mm.}$; about two thirds out on arm, plates proportionately longer, outer corners much rounded, inner side shorter than outer so that lateral sides slope; length to breadth, 1 : 2$^{mm.}$; length of inner side, 1.4$^{mm.}$; close to tip of arm, plates wedge-shaped, the point inward, length to breadth, .4 : .4$^{mm.}$, outer side slightly curved. Disk, granulation of upper surface pretty close and regular, about one hundred and eighty grains to a square *mm.*; granulation of interbrachial spaces below same as that above, and extending to bases of mouth-papillæ excepting side mouth-shields; scales at base of arm completely covered by granulation. Arm-spines short, stout, flat, rounded, varying very little in size on the same joint; upper ones, however, a little largest and longest. Second and third joints, three spines, lengths to that of under arm-plate, .8 : 1; fourth joint, four spines; fifth joint, five spines; sixth joint, six spines; seventh joint, eight spines; eighth joint, nine spines; length of uppermost and lowest spines to that of under arm-plate, .8, .8 : 1.2; a few of upper spines are as long as 1$^{mm.}$; about two thirds out on arm, six spines, length to that of under arm-plate, .6 : 1; close to tip of arm, four very short, stout spines, length to that of under arm-plate, .4 : .6. Tentacle-scales: the two that belong to each tentacle continue till near tip of arm, where there is only one; inside scale much like an arm-spine, but broader and flatter; outside scale shorter, being cut square off at the end. Color, in alcohol: disk, above, with a dirty white patch in centre; rest of upper surface having a ground-tint of light yellowish-brown (yellow ochre and vandyke brown) slightly clouded with olive; arms above dirty olive, irregularly barred with same brown as ground-tint of disk, but lighter; bars include usually two or three joints; lower surface of disk and arms, uniform dirty white, with a brown tint just on edges of disk; arm-spines white.

Variations. — The color is almost as variable as in *O. appressa.* Often the disk is nearly white above, while the arms are dark green, and banded. According to drawings in possession of Prof. Agassiz, a common pattern in the living animal is a dark sap-green disk, with a blotch of white in the centre, and arms banded with darker and lighter green. Specimens with a disk of 14$^{mm.}$ have the under arm-plates more octagonal and proportionately longer than among the larger.

This species stands between *O. brevispina* and *O. olivacea;* from the former it is distinguished by proportionately thicker arms and stouter disk, and by proportions of under arm-plates it is also a larger species,

twenty millemeters being about an average diameter for the disk of an adult; from *O. olivacea* it is distinguished by its barred arms and varied coloration; and from both of these by having no naked scales at the base of the arm.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
111	. .	6	Charleston, S. C.	. . . . .	Prof. Agassiz.	Alcoholic.
112	. .	1	Sullivan's Island, S. C.	. . . . .	Prof. Agassiz.	Dried.
113	. .	3	Charleston, S. C.	. . . . .	Prof. F. S. Holmes.	"

Ophiura olivacea Lyman.

Ophioderma olivaceum Ayres; Proceed. Boston Soc. Nat. Hist., IV. p. 134. 1852.

Special Marks. — Uniform greenish above, without bands on arms; lower arm-plates nearly square, with outer side curved; arms broad near base, quickly tapering; side mouth-shields naked.

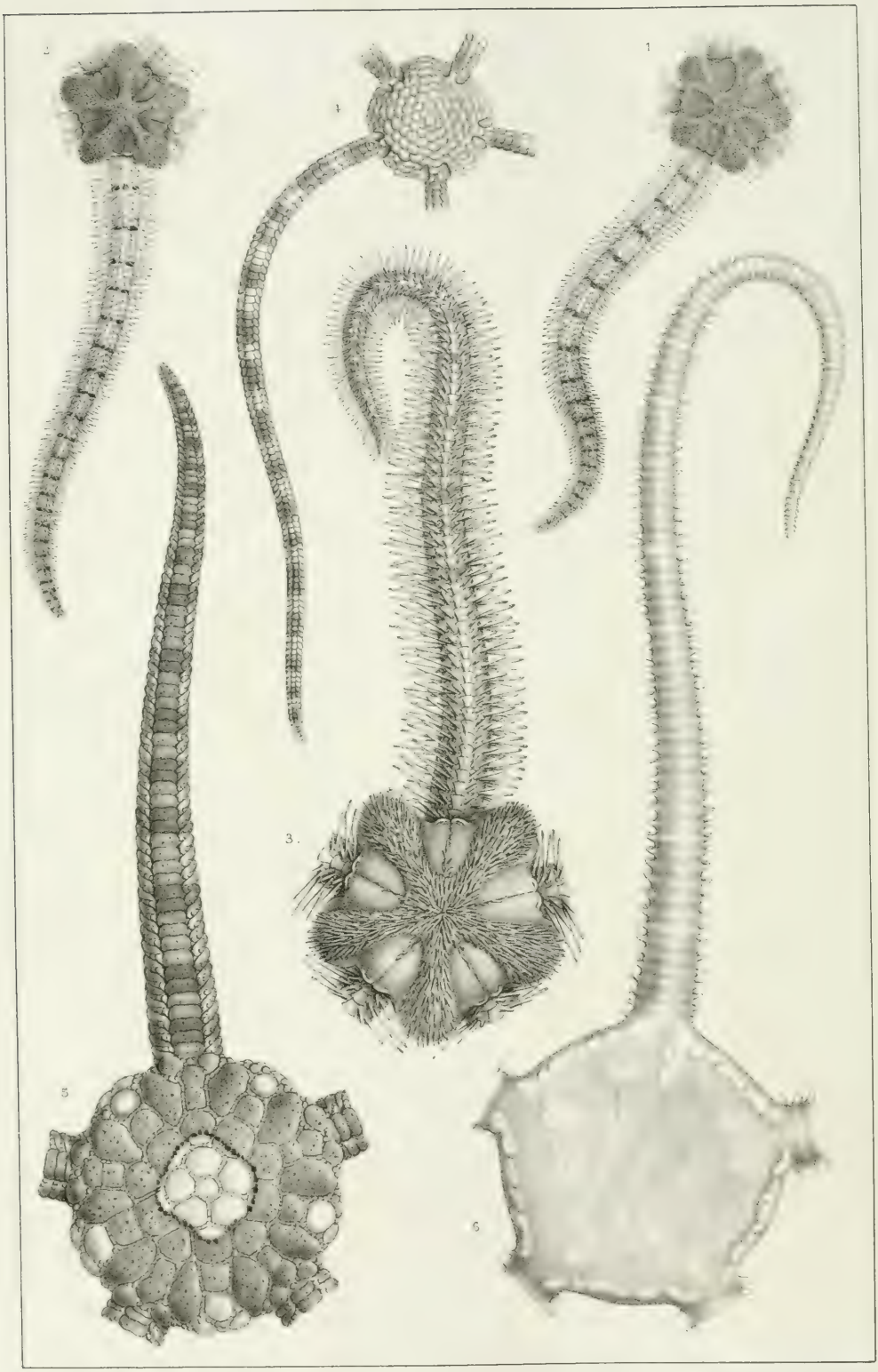
Description of a Specimen. — Diameter of disk, 11$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 4.7$^{mm.}$; width of arm without spines, 2.2$^{mm.}$; length of arm about 52$^{mm.}$; distance from outer edge of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 2.3 : 2.2. Mouth-papillæ sixteen, outer one small, next four stout, squarish, rounded; innermost one longest, flat, and tapering; the rest like innermost one, but smaller. Teeth five or six, similar among themselves, flat, tapering, pointed. Mouth-shields heart-shaped, with a truncated angle turned inward, and inner sides a little re-enteringly curved; length to breadth, 1.5 : 1.5. Side mouth-shields small, and almost wholly naked, connecting innermost under arm-plate with mouth-shield. Under arm-plates squarish, rather broader than long, pretty strongly overlapping, bounded without by a long curve, within and on the sides by nearly straight lines, which are, however, slightly re-enteringly curved, length to breadth (twelfth plate), 6 : 8. As the plates overlap a good deal, the inner laterals are very short, while the outer laterals form a common curve with the outer side; hence comes the characteristic, even, square look of the plates. First plate narrow oval, with a projection without, separating a pair of pores; next three or four plates with rather longer inner laterals, and more curved outer sides, than those beyond; about two thirds out on arm, plates no longer overlap, so that inner laterals are well developed, giving

the plates nearly an octagonal shape. Side arm-plates encroaching less than usual between lower arm-plates. Upper arm-plates broader than long, bounded, without and within, by very straight, clean lines; inner side shorter than outer; outer corners well rounded; three or four plates enclosed by projections from disk, and modified in form accordingly; length to breadth (sixth plate), .9 : 1.8; about two thirds out on arm, same general shape, but proportionately longer. Disk, except side mouth-shields and a very few naked scales at base of arm, closely covered with very fine grains, about 170 to a square *mm.* Arm-spines six, of equal length and size, somewhat flattened, but little tapering, points rounded; length to that of under arm-plate, .5 : .6. Inside tentacle-scale oblong, with straight sides and rounded point; length to that of under arm-plate, .4 : .6; outside scale shorter and broader. Color, in alcohol: above, uniform dark sap-green, without bands on the arms; below, the same, but lighter; interbrachial spaces slightly mottled, and of a darker shade than arms.

Variations. — The specimen above described is below the ordinary size of well-grown individuals. A specimen with a disk 14.5[mm.] in diameter had eight strongly flattened arm-spines, fifteen mouth-papillæ, and mouth-shields longer than broad, and pretty regular heart-shaped; disk with about 130 grains to a square *mm.* The number of teeth varies somewhat; four seems to be most common. A specimen with disk 16[mm.] had arms 74[mm.], and only seven arm-spines. The upper arm-spines are often, in large specimens, a little longer than the lower.

When alive, *O. olivacea* is of a bright green color. It lives on sandy bottom, among eel-grass, and is active in its motions (Ayres). It is, at first sight, very like *O. brevispina*, but is readily distinguished by more flattened arm-spines, and by the form of the under arm-plates, which are nearly square, with straight lateral sides, instead of hexagonal, with the lateral sides decidedly re-enteringly curved. It is further remarkable for uniformly colored arms without bands. Young or partly grown specimens, however, are often undistinguishable from *O. brevispina.* From other species with equal spines and covered radial shields, it is distinguished as follows: from *O. brevicauda*, by finer granulation and longer arm-spines; from *O. guttata*, by whole upper arm-plates; from *O. variegata*, by shorter arm-spines; and from *O. Januarii*, by shorter and broader arm-spines.

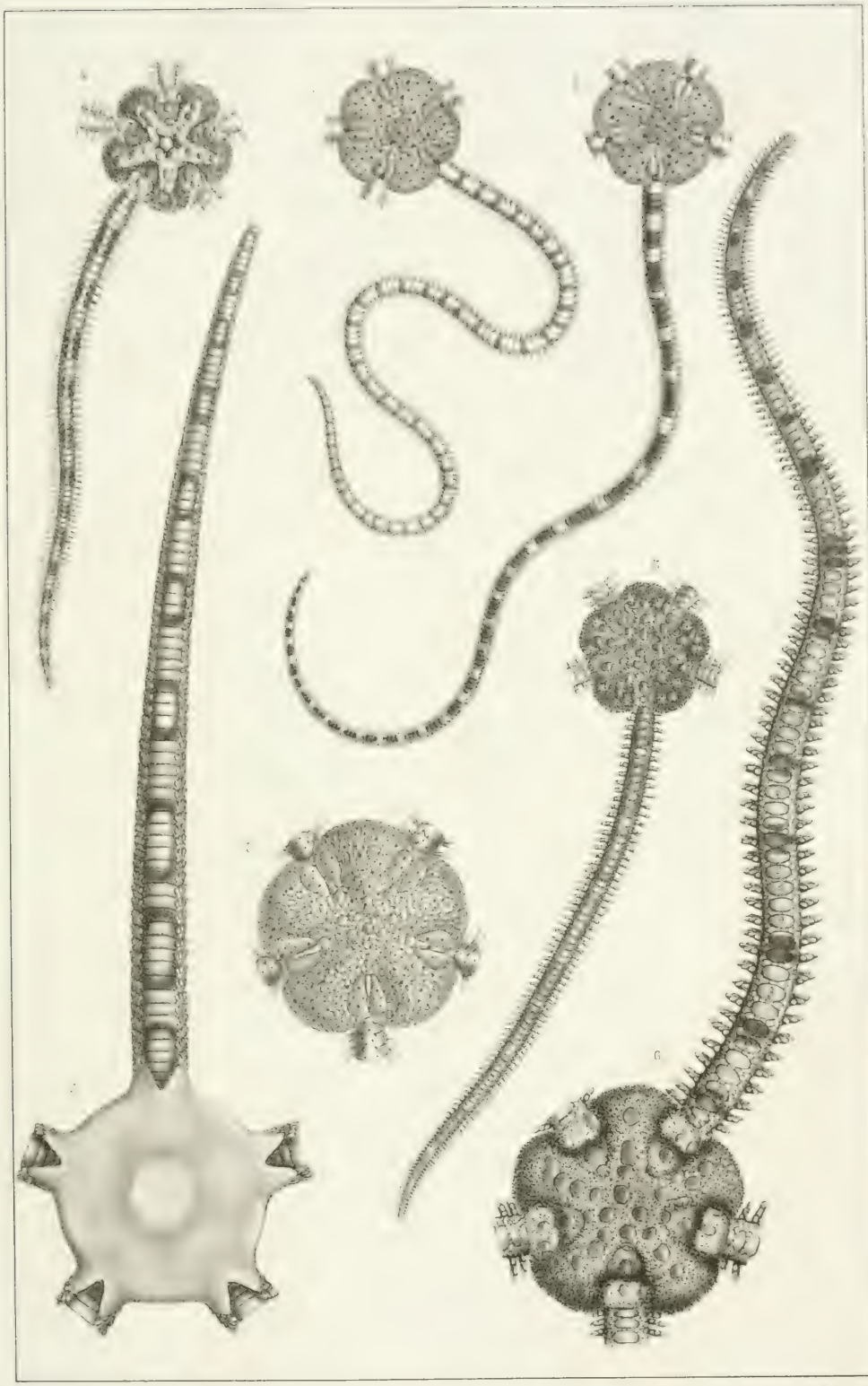
There is in the Philadelphia Academy a specimen, collected on the shores of Rhode Island by Prof. A. D. Bache, which agrees entirely with this species, except that it has *radial shields.* It is possible that the grains have been rubbed off the radial shields, after the animal was dry. Another specimen, in the Museum of Comparative Zoölogy at Cambridge, has, outside four of the mouth-shields little supplementary



Burkhardt & Sourer

Printed at J.H. Bufford's

1-3 Ophiothrix angulata Ayr. — 4. Ophiolepis Garretti Lym.
5. Ophiolepis elegans Ltk. — 6. Ophiomyxa flaccida Ltk



Burkhardt & Sonrel

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1-3. Hemipholis cordifera Lym. — 4-6. Ophiopholis bellis Lym.
7. Ophiura Holmesii Lym.

mouth-shields, such as are found in *Ophiarachna*. It would seem that this species has variations similar to those of *O. longicauda*.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
100	. .	2	New Bedford, Mass.	May, 1851.	Prof. Agassiz.	Alcoholic.
101	. .	1	Dartmouth.	. . . . .	Prof. Agassiz.	Dried.
102	. .	1	Sag Harbor, L. I. ?	. . . . .	Dr. Ayres ?	Alcoholic.
?103	1193	2	Beaufort, N. C.	. . . . .	Wm. Stimpson.	"
444	. .	12+	Beaufort, N. C.	. . . . .	A. S. Bickmore.	"
			Smithsonian Institution.			
1048	. .	1	Old Point Comfort, Va.	. . . . .	. . . . .	Alcoholic.
1193	. .	12+	Beaufort, N. C.	. . . . .	Wm. Stimpson.	"

Ophiura Januarii Lyman.

Ophioderma Januarii Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophioderma Januarii Lütken. Addit. ad Hist. Oph., p. 97.

Special Marks. — Arm-spines nearly as long as joints, round, slender; arms tapering, slender. Color, variegated greenish-gray, above; below, light straw-color. Side mouth-shields naked.

Description of a Specimen. — Diameter of disk, 17$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 7.2$^{mm.}$; width of arm, without spines, 3.5$^{mm.}$; length of arm, 82$^{mm.}$; distance from outer side of mouth-shield to inner point of teeth, to that between outer corners of mouth-slits, 4 : 4. Mouth-papillæ sixteen to eighteen, of more even size than usual; second and third flat, squarish, with rounded edges; the rest rounded, spiniform, nearly equal. Teeth five; uppermost and lowest flat and tapering, the former longer; other three flat and square. Mouth-shields short heart-shaped; length to breadth about 1.7 : 2. Side mouth-shields broad, rather conspicuous, naked. Under arm-plates, near base of arm, broad octagonal, with four outer corners more or less rounded; length to breadth (eighth plate), 1 : 1.5; (twelfth plate), 1 : 1.3. First plate nearly oval, proportionately larger than usual; length to breadth, .8 : 1.3. About two thirds out on arm, the plates become nearly hexagonal, owing to encroachment of side arm-plates, which may be seen very plainly, both from above and from below. Upper arm-plates broader than long, bounded within and without by straight lines; inner side shorter; outer corners well rounded; three or four plates enclosed by projections from disk, and modified in

shape accordingly; length to breadth (sixth plate), 1.1 : 2.8. Disk evenly and finely, but not very closely, granulated throughout, except side mouth-shields, and a few naked scales at base of arm; about 80 grains to a square *mm.* Arm-spines very characteristic, eight (rarely nine) rounded, slender, slightly tapering, almost as long as joints, of even length and size; length to that of under arm-plate, .9 : 1. Inside tentacle-scale oblong, with a rounded end, rather delicate; length to that of under arm-plate, .7 : 1; outside scale of about the same width, but shorter, and cut off obliquely at the end. Color, in alcohol: above, disk dull greenish-gray round edges, fading to dull yellowish-brown towards centre; arms banded with darker and lighter shades of dull greenish-gray, each band occupying from two to five joints; outer edges of upper arm-plates finely marked with short, longitudinal lines of brown; below, uniform pale straw-color.

This delicate and elegantly formed species may at once be distinguished from other *Ophiuræ* with equal arm-spines and covered radial shields, by its long, rounded, slender arm-spines.

LIST OF SPECIMENS.

Catalogue Number.		Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
107	49	1	Brazil.	. . . . .	Univ.Mus. Copenhagen.	Alcoholic.
			Smithsonian Institution.			
1002	. .	1	Brazil.	. . . . .	Univ.Mus. Copenhagen.	Alcoholic.

Ophiura lævis Lyman.

Stella lævis Rondelet. De Pisc. Mar., p. 120. 1554.
Stella lumbricalis; *Stella lævis* Linck. De Stel. Mar., p. 46. 1733.
? *Stella lumbricalis longicauda* Linck. De Stel. Mar., p. 47, tab. XI. fig. 17. 1733.
Ophiura lacertosa Lamk. Syst. Anim. s. Vertèb., p. 351. 1801.
Ophioderma longicauda Müll. & Trosch. Syst. Asterid., p. 86. 1842.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
114	. .	1	. . . . .	. . . . .	. . . . .	Dried.
411	. .	. .	Azores.	. . . . .	. . . . .	Alcoholic.
426	. .	. .	Spain.	. . . . .	Jardin des Plantes.	"
427	. .	. .	Alger.	. . . . .	" " "	"

Ophiura cinerea Lyman.

Ophioderma cinereum Müll. & Trosch. Syst. Asterid., p. 87. 1842.
Ophioderma Antillarum Lütken. Addit. ad Hist. Oph., p. 88.

Special Marks. — A large species. In adult, upper arm-plates much broken; mouth-shields broad heart-shaped; mouth-papillæ crowded, numerous, and pretty equal (about twenty); arms very round, tapering.

Description of a Specimen. — Diameter of disk, 20$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 8$^{mm.}$; greatest width of arm without spines, 4.2$^{mm.}$; length of arm, 97$^{mm.}$; distance from outer edge of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 4 : 4.4. Mouth-papillæ, nineteen to twenty-one to each angle of mouth (usually twenty), outer one very long and slender, running *above* next one or two papillæ, when mouth is tight shut; two innermost ones, pointing to centre of mouth, much stouter than others; of remaining papillæ, four inner ones somewhat weaker than four outer ones; all papillæ crowded, pointed, rounded. Teeth five, flat, somewhat blunt; the uppermost one longer and sharper. Mouth-shields short heart-shaped, point inward, well rounded, length to breadth, 1.8 : 2.2; madreporic shield more rounded, and somewhat larger, near its centre a rounded depression; side mouth-shields entirely covered by granulation. Under arm-plates thick, strong, and firmly set; bounded by a curved outer side, two long lateral sides a little re-enteringly curved, two very short inner laterals, and an inner side, nearly straight; towards end of arm, each plate is an octagon, its lateral sides being very long, and its outer and inner laterals very short; first plate small, irregular oval, with a slight peak inwards, length to breadth, .8 : 1.4; second plate, 1.2 : 1.4; eleventh plate, 1.2 : 1.4; about two thirds out on arm, length to breadth, 1.2 : 1; at tip of arm, plates nearly heart-shaped, with point inward. Side arm-plates thick, compact, closely soldered with surrounding parts, their outer edges very conspicuous by reason of shortness of arm-spines; not meeting above at all, and below only at very tip of arm. Upper arm-plates are all, with exception of first rudimentary one, and a few at tip of arm, broken in several pieces, irregular in form, and varying in number from two to five, according to size of plate; each plate, considered as a whole, makes a belt across arm, of which the inner side is shorter than the outer; incision in disk embraces first three plates, which are modified in shape accordingly; fourth plate, broken in four or five pieces, length to breadth, 1.2 : 3.6; about two thirds out on arm, some plates are found whole, but most are broken in two or three pieces; length to breadth, 1 : 2.6; close to tip of arm,

plates four-sided, outer side curved, and longer than inner side, length to breadth, .6 : .8. Disk : above, granulation very even, close, and fine, about one hundred grains to a square *mm.* Radial shields regular oval, standing nearly opposite outside lines of arms, quite smooth, length to breadth, 1.6 : 1.2 ; between radial shields and base of arm there are sometimes one or two rounded scales ; edges of incision in disk lined with small, thick, overlapping scales, varying in length from .2 to 1$^{mm.}$; at inner angle of incision these scales form a single row, but at outer angles they make a triangular cluster of six or seven rows, and are continued, over edge of disk, to its under surface, and reach as far as outer pair of genital slits ; they make, on under surface of disk, three irregular rows, interspersed with grains ; all other parts of interbrachial spaces, except mouth-shields, covered with a close granulation, quite to the bases of the mouth-papillæ. Genital slits, length of outer pair, 1.4$^{mm.}$, of inner pair, 1.2$^{mm.}$. Arm-spines short, stout, increasing in size from uppermost one to lowest, which is considerably the largest ; upper ones more pointed and rounded, lower ones more blunt and flattened ; second joint, two spines, length to that of lower arm-plate, .8, 1.2 : 1.2 ; seventh joint, five spines ; eighth joint, six or seven spines ; tenth joint, eight spines, .4, .6, .6, .8, .8, .8, 1, 1.2 : 1.2 ; about two thirds out on arm, six spines ; near tip of arm, four very short, thick, pointed spines. Tentacle-scales two, continued close to tip of arm ; inside one somewhat larger and longer, thin, cleanly rounded at end ; outside one similar, but cut off square at end ; length to that of under arm-plate near base of arm, inside scale, .8 : 1.2 ; outside scale a trifle shorter. Color, in alcohol : disk, above, brownish gray (burnt umber and neutral tint), with fine specks of umber brown, each radial shield bounded by a line of umber brown ; below, interbrachial spaces light brownish-gray, with a few specks of light umber-brown ; mouth-shields and angles of mouth light umber-brown ; mouth-papillæ white ; under and side arm-plates like interbrachial spaces below, but variously clouded, and marked with white and with shades of brown ; arm-spines white, with a brown line round the base ; upper arm-plates same as upper side of disk, but variously lined and marked with dark-brown ; the breaks in the plates are marked with this color.

Variations. — This species is always sober in its colors, the chief variation being in intensity ; old specimens are sometimes nearly black, while others are dark gray, speckled with umber brown. The young might well be mistaken for another species. A specimen with a disk of 9.5$^{mm.}$ had arms 32$^{mm.}$. Upper arm-plates regular and unbroken, covering only a part of upper surface of arm, their inner side much shorter than the outer ; seven arm-spines ; sixteen to eighteen mouth-papillæ ; radial shields large, oval, length 1.5$^{mm.}$. Color, above, very light brown,

with specks of umber brown on disk, and bands of the same on arms; below, nearly white. The upper arm-plates are usually not broken until the animal has a disk at least 12^{mm}.

This species differs from others with radial shields and unequal spines, as follows: from *O. rubicunda*, in position and shape of mouth-shields; from *O. panamensis*, in having broken upper arm-plates, and in shape of mouth-shields; from *O. squamosissima*, in having upper arm-plates broken, instead of scaly.

A comparison of the original of Müller & Troschel in the Vienna Museum shows that their specimen is a young one of this species. Dr. Lütken's name *Antillarum* must therefore be dropped.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
72	. .	5	Tortugas, Fla.	Mh. 15-20, '58.	J. E. Mills.	Alcoholic.
73	. .	1	Tortugas, Fla.	Early Mh. '58.	J. E. Mills.	"
74	. .	1	Tortugas, Fla.	Feb. 1856.	Theo. Lyman.	"
75	. .	1	Florida.	. . . . .	Prof. Agassiz.	"
76	. .	2	Florida.	. . . . .	Prof. Agassiz.	"
77	. .	1	Hayti.	. . . . .	Dr. D. F. Weinland.	"
78	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
79	. .	1	Florida.	. . . . .	J. E. Mills.	"
80	. .	3	Cape Florida.	. . . . .	G. Wurdeman.	"
81	48	1	West Indies.	. . . . .	Univ. Mus. Cop'hagen.	"
82	. .	3	Jeremie; Hayti.	. . . . .	Dr. D. F. Weinland.	"
83	. .	1	Florida.	. . . . .	Prof. Agassiz.	Dried.
84	. .	1	. . . . .	. . . . .	. . . . .	"
85	. .	2	Florida.	. . . . .	G. Wurdeman.	"
86	. .	2	Gulf of Mexico, south of Vera Cruz.	. . . . .	S. S. Haldeman.	"
413	. .	. .	Hayti.	. . . . .	Dr. D. F. Weinland.	Alcoholic.
			Smithsonian Institution.			
1046	. .	3	Tortugas, Fla.	. . . . .	Capt. Woodbury.	Alcoholic.
994	. .	1	Garden Key, Tortugas.	. . . . .	G. Wurdeman.	"
1013	. .	1	Key Biscayne, Fla.	. . . . .	G. Wurdeman.	"
1061	. .	1	Aspinwall.	. . . . .	Rev. T. Powell.	"
1072	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1073	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1106	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1178	. .	1	Florida.	. . . . .	. . . . .	"
1153	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophiura rubicunda Lyman.

Ophioderma rubicunda Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophioderma rubicunda Lütken. Addit. ad Hist. Oph., p. 90.

Special Marks. — Color, above, variegated lake-red; mouth-shields much rounded; second mouth-papilla very broad; side mouth-shields naked.

Description of a Specimen. — Diameter of disk, 17.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 6.8$^{mm.}$; width of arm, without spines, 3.5$^{mm.}$; length of arm, 103$^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 3.5 : 3.6. Mouth-papillæ, fourteen to sixteen; three outer ones broader than the rest; second one, in particular, very flat and broad, often as wide as .7$^{m.}$; other mouth-papillæ flattened spiniform; two innermost ones somewhat broader, and shaped like short spear heads. Teeth five, short, flat, stout, with rounded edges, rather broader than long, except uppermost one, which is longer and more tapering. Mouth-shields crowded close against mouth-papillæ, much rounded, heart-shape, with point inward; length to breadth, 2 : 2. Side mouth-shields covered by grains, except a small round piece, which connects mouth-shield with outer mouth-papilla and innermost under arm-plate. Under arm-plates overlapping, rather broader than long, bounded without by a clean curve, on the sides, by re-entering curves (where tentacle-scales come), and within by two short, slightly-sloping, inner laterals, and an inner side, which is a little re-enteringly curved; length to breadth (twelfth plate), 1.2 : 1.5. First plate diamond oval, length to breadth, .7 : 1.3; second plate, length to breadth, 1.2 : 1.2; the plates then grow proportionately wider to the seventh, which has the length to breadth, 1.1 : 1.6; the proportions of twelfth plate are typical, and are continued till close to tip of arm. Side arm-plates intruding a little between upper arm-plates, but not meeting above and below till very tip of arm. Upper arm-plates much broader than long, covering upper surface of arm completely, so that side arm-plates are scarcely to be seen; outer and inner sides sensibly straight, the latter rather shorter, so that lateral sides slope a little; outer corners rounded, length to breadth, 1 : 3; about two thirds out on arm same general shape, but longer, length to breadth, .8 : 1.8; first three plates enclosed by scaly prolongations of disk, and consequently more or less rudimentary, especially first plate, which almost disappears. Granulation of disk close, fine, regular, covering every part, except radial shields, part of side mouth-shields, and fine scales at base of arms, and extending quite to base of mouth-papillæ; about 144 grains to a square *mm.* Radial shields

small, oval, length 1mm.; there are sometimes, near base of arms, above, one or two little naked rounded plates. Arm-spines eight or nine, lowest one much longest and largest; flattened, slightly tapering, rounded at end; rest of spines more flattened, short, and tapering, increasing gradually in length from above downward; lengths to that of lower arm-plate: first spine, .9 : 1.2; second spine, .8 : 1.2; fifth spine, .6 : 1.2; ninth spine, .5 : 1.2. About two thirds out on arm, only six spines, which are sharp and rounded. Tentacle-scales, inside one clean oval, rather thin; length to that of under arm-plate, .7 : 1.2; outside one shorter, rather broader, cut square off at the end. Color, in alcohol: above, disk uniform dull pink-red (lake and Indian red), arms finely and irregularly mottled and banded with lighter and darker shades of the same; below, uniform in color, which is the same as that above, but much lighter; arms somewhat lighter than interbrachial spaces.

Variations. — Another specimen was somewhat darker than the above, had the disk finely mottled, and the arms mottled, red and light yellowish. The arms are usually, in well-grown specimens, about five times the diameter of the disk. There is a so-called variety of this species, which may be said to have the under side of *O. cinerea*, and the upper side of *O. rubicunda*. The mouth-shields are as in *O. cinerea*, and the mouth-papillæ, though finer and more irregular, are also somewhat alike; the mouth-shields are surrounded by granulation, which completely covers the side mouth-shields. The specimen I examined had a disk of 20mm., while the length of the arms was only four times as great. It is manifestly not philosophical to suppose, as Dr. Lütken does, that this form is a *hybrid* between *O. rubicunda* and *O. cinerea*. No hybrids occur between the other closely allied West Indian Ophiurans. Among many hundred specimens of *Ophiocoma crassispina* and *O. Riisei* that I have examined, I never saw one that even looked like a hybrid; and the same is true of other species. This form is certainly a curious one; and it seems not improbable that it may prove a new species.

O. rubicunda is distinguished from *O. cinerea* by smaller radial-shields and whole upper arm-plates, and, by the latter character, from *O. squamosissima;* from *O. panamensis*, by larger mouth-shields, naked side mouth-shields, outer mouth-papillæ broader, &c.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
104	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
105	50	1	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
106	. .	2	Cape Florida.	. . . . .	G. Wurdeman.	Dried.
			Smithsonian Institution.			
1074	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1105	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1152	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiura panamensis Lyman.

Ophioderma panamensis Lütken; Addit. ad Hist. Oph., p. 91.

Special Marks. — Color, in alcohol, above, greenish gray, with a central light mark; arms the same, alternating with lighter and darker bands; mouth-shields a good deal rounded; arm-spines stout, blunt, little tapering; side mouth-shields granulated.

Description of a Specimen. — Diameter of disk, $25^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $8.5^{mm.}$; width of arm without spines, $5^{mm.}$; length of arm, $102^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 4.3 : 4.6. Mouth-papillæ, nineteen or twenty to each angle of mouth; outermost one long and spine-like, reaching above its next neighbors; the next one, or two, flat and squarish; the rest fine and spiniform, except the innermost, which is much larger and stouter. Teeth five, upper and under ones flat and pointed; the others flat, squarish, with a curved cutting edge; they are unusually short. Mouth-shields broader than long, irregular oval, with a rounded angle within; length to breadth, 2.2 : 3. Under arm-plates octagonal, with rounded corners; about as broad as long; a little overlapping; length to breadth (twelfth plate), 1.4 : 1.5. Upper arm-plates much broader than long, overlapping; outer side nearly straight, with a slight re-entering curve in the middle; lateral sides well rounded; length to breadth (ninth plate), 1.4 : 4; three or four plates inclosed by the incisions in the disk. Disk, above and below, finely and closely granulated, except on radial-shields, and some narrow lines of scales at base of arm, which run under the disk as far as the inner end of the outer genital slit; about 120 grains to a square *mm.* Radial shields oval; length to

breadth, 1.5 : 1.3. Arm-spines ten, rounded, little tapering, little flattened, decidedly stout; of nearly equal length, except the two lowest; lengths of uppermost and of the lowest to that of under arm-plate (thirteenth joint), .8, 1.1 : 1.4. Near the tip of the arm, the spines are six in number, and more rounded and slender. Tentacle-scales large; inside one long, regular oval; outside one unusually broad. Color, in alcohol: above, greenish gray, with a white mark in the centre; arms banded with lighter and darker greenish-gray; under surface uniform light greenish-gray.

Variations. — The color varies in intensity, sometimes being clouded with brownish, and again tending to light greenish; the central white spot, though common, is not always found. The young of this species have no *radial shields;* one, with a disk of $7^{mm.}$, was just beginning to show them; while another, with a disk of $11^{mm.}$, was still entirely granulated. This case is just reversed in *O. teres.* A specimen with a disk of $6.5^{mm.}$ had already eighteen mouth-papillæ, but only seven arm-spines. The proportions of the disk to the arms were as follows, in different specimens: 26 : 96, 21 : 70, 20 : 75, 14 : 46, 13 : 52, 9.5 : 40, 6.5 : 23; so that the disk is usually contained in the arms from three and a half to four times.

This species differs from others with unequal arm-spines and with radial shields, as follows: from *O. cinerea* and *O. squamosissima,* in having the upper arm-plates undivided; from *O. rubicunda,* in the different shape and position of the mouth-shields.

I am not quite sure that this is the true *Ophioderma panamensis* Ltk. Dr. Lütken got his specimen from the Smithsonian Institution. There are now at the Smithsonian Institution and at the Museum of Comparative Zoölogy many specimens of the *Ophiura* here described; *besides* which there is a single specimen (1181 Smithson. Instit.) which may be the same species, or a variety; the arm-spines are sharper, a little, and there are dark, longitudinal lines on the outer edges of the upper arm-plates. *Neither* of these agrees perfectly with Lütken's description; the differences consisting in slight variations in the spines, and in the markings of the upper arm-plates; still, they are all probably the same, and are therefore here included under *O. panamensis.*

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
108	. .	5	Acapulco.	. . . . .	Alex. Agassiz.	Alcoholic.
109	. .	2	Panama.	. . . . .	Alex. Agassiz.	"
110	1188	2	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"
			Smithsonian Institution.			
? 1181	. .	1	Pan	. . . . .	Rev. T. Powell.	Alcoholic.
1055	. .	1	Panama.	. . . . .	Mr. Sternberg.	"
1069	. .	8	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"
1188	. .	9	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"

Ophiura appressa Say.

Ophiura appressa Say. Journ. Phil. Acad., V. p. 151. 1825.
Ophioderma virescens Lütken. Addit. ad Hist. Oph., p. 92.

Special Marks. — Color grayish, or variously marbled dark green and yellowish; arm-spines nine, rather short, flattened; arms stout; mouth-shields broad heart-shaped.

Description of an Individual. — Diameter of disk, 16$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 5.2$^{mm.}$; width of arm without spines, 2.7$^{mm.}$; length of arm, 62$^{mm.}$; distance from outer edge of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 2.7 : 2.7. Mouth-papillæ, eighteen to twenty to each angle of jaw, strongly flattened, longer than broad, edges rounded; second, third, and fourth (from without), and also two innermost ones, broader than the others; outermost one of all rounded, sharp, tapering. Teeth five, broad, stout, somewhat pointed; uppermost one narrow and sharp; uppermost and lowest smaller than other three. Mouth-shields very broad, rounded, heart-shape, length to breadth, 1.3 : 2; outer side usually straight, or slightly re-entering; corners cleanly rounded. Side mouth-shields entirely covered, except a small rounded piece, connecting mouth-shield with innermost arm-plate. Under arm-plates a little overlapping, longer than broad;* in front rounded; sides re-enteringly curved, where tentacle-scales encroach; inner laterals very short, and sloping towards middle of arm; inner side straight; length to breadth, twelfth plate, 1 : .8. First plate oval diamond-shape; length to breadth, .7 : 1. Second plate like those beyond, but rather shorter and wider;

* The form of the arm-plates applies to the portion that *can be seen* without preparation; some parts are hidden by the tentacle-scales and the neighboring plates.

length to breadth, .9 : 1. The plates maintain the same shape till near the point of the arm, where the inner lateral sides begin to grow proportionately longer, and at the very tip the shape becomes almost triangular. Side arm-plates very evenly curved, on their outer side encroaching a little on upper arm-plates, so that their upper edges can be well seen from above. Upper arm-plates broader than long, bounded without and within by nearly straight lines (outer side sometimes a little re-enteringly curved), sides well rounded, overlapped on their inner portion by side arm-plates. First plate small, and partly covered by fine scales which are at the base of the arm; length to breadth, .6 : 1.8; twelfth plate, length to breadth, 1 : 2.2. About two thirds out on arm, the plates begin to be more overlapped by the side arm-plates, which makes the lateral sides more sloping, and inner side shorter, so that, in the last three or four joints, the plates are triangular, the side arm-plates meeting above. Inner pair of genital slits granulated; outer pair granulated on one side, and scaly on the other. Arm-spines commonly nine, short, flattened, tapering only near the point, which is rounded; of nearly equal length, except lowest one, which is decidedly longer, and does not taper at all; lengths to that of lower arm-plate (twelfth joint), lowest spine, .9 : 1; second, .7 : 1; third, .6 : 1; eighth .5 : 1; second, third, and fourth joints, three spines; two uppermost much thinner; fifth and sixth, five spines; seventh and eighth, seven spines; ninth, eight spines; two thirds out on arm there are six spines, and at the very tip, only four. Granulation of disk very close, smooth, and even, covering every part, except a few scales at base of arms, and extending below quite to the mouth-papillæ; grains remarkably round and smooth, about 110 to a square *mm.* Two tentacle-scales; inside one longer, oblong, with rounded corners, length, .7$^{mm.}$; outside one about two thirds as long, somewhat broader, and cut off square at the end. Color, in alcohol: above, ground color yellowish white, with irregular stripes and patches of greenish black on disk, and belts of the same on arms; the edges of the dark arm-plates are, however, speckled with lighter; below, interbrachial spaces dirty olive, with two large spots of whitish in each; chewing apparatus dirty white, ground color of arms the same, marked and banded with different shades of brownish olive.

Variations. — It is hard to find two specimens colored alike. There are two chief varieties, the gray, which was that described originally by Say, and the variegated green. The gray is more uniform, having usually the disk greenish gray, with fine points of darker and lighter, and the arms irregularly banded with darker, the lower parts being similar, but lighter. The green variety may be marbled, spotted, and lined with every possible pattern of green and whitish or yellowish; sometimes a specimen may be seen almost pure white. The gray va-

riety seems more abundant near St. Thomas, and the green, at Cape Florida. The length of the arms is four or five times the diameter of the disk, and the proportion is about the same in those of moderate size and in the largest. The side mouth-shields may be entirely covered by grains.

This species comes among those that have the lowest arm-spine longest, and have no radial shields. It differs from *O. Elaps* in the number and form of the arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
57	. .	12+	Florida.	. . . . .	G. Wurdeman.	Alcoholic.
58	. .	8	Florida.	. . . . .	Prof. Agassiz.	"
59	53	4	West Indies.	. . . . .	University Museum, Copenhagen.	"
60	. .	10	Tortugas, Fla.	Mar. 15, '58.	J. E. Mills.	"
61	. .	2	Tortugas, Fla.	July, 1859.	Capt. Woodbury.	"
62	. .	4	Tortugas, Fla.	Ap. 21,22,'58.	J. E. Mills.	"
63	. .	3	Bay of Cumana.	. . . . .	Capt. Couthouy.	"
64	. .	4	Cape Florida.	Apr. 18, '58.	G. Wurdeman.	"
65	. .	1	Jeremie ; Hayti.	. . . . .	Dr. D. F. Weinland.	"
66	. .	7	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
67	. .	5	Cape Florida.	Apr. 1858.	G. Wurdeman and J. E. Mills.	"
68	. .	1	Charleston, S. C.	. . . . .	Prof. F. S. Holmes.	Dried.
69	. .	12+	Florida.	. . . . .	G. Wurdeman.	"
70	. .	12+	Florida ?	. . . . .	. . . . .	"
71	. .	3	Florida.	. . . . .	Prof. Agassiz.	"
412	. .	. .	Key West.	. . . . .	. . . . .	Alcoholic.
			Smithsonian Institution.			
986	. .	4	Cape Florida.	. . . . .	G. Wurdeman.	Alcoholic.
981	. .	2	Garden Key, Tortugas.	. . . . .	G. Wurdeman.	"
1071	. .	5	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1082	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1104	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1179	. .	12+	Florida.	. . . . .	. . . . .	"
1180	. .	1	Tortugas, Fla.	. . . . .	Capt. Woodbury.	"
1154	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1192	. .	2	Cape Florida.	. . . . .	G. Wurdeman.	Alcoholic.

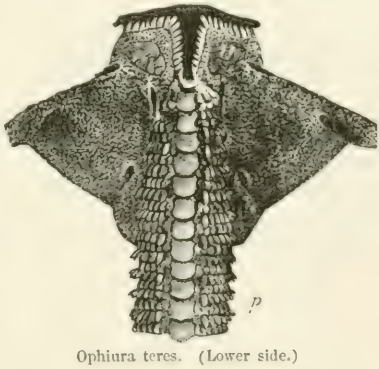
Ophiura teres Lyman. (Fig. 1.)

Ophiura teres Lyman. Proceed. Boston Soc. Nat. Hist., VII p. 198. 1860.

Special Marks. — A very large species. Upper arm-plates broken; arms short, rounded.

Description of a Specimen. — Diameter of disk, 32$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 12$^{mm.}$; width of arm, without spines, 7$^{mm.}$; length of arm, 133$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 5 : 5.6. Mouth-papillæ, about eighteen to each angle of mouth, small, tooth-like, somewhat crowded; the innermost, and outermost but one, on each side, broader and larger than their neighbors. Teeth six, broad, flat, short, with the free edge curved, the upper ones more pointed. Mouth-shields very broad heart-shape, usually presenting three rounded lobes, of which one is directed inward; length to breadth, 2.5 : 3.5. Side mouth-shields covered by granulation of disk. Under arm-plates small, squarish, bounded without by three sides, with much rounded angles, and within by a slightly curved line; length to breadth (thirteenth plate), 1.5 : 2. The first five plates are smaller and narrower; and between the first and second, second and third, and third and fourth, there is a pair of pores. Upper arm-plates very short and wide; length to breadth, 1.7 : 6.5. All the plates, except those just at the tip of the arm, are broken in irregular pieces; those near base of arm usually in five; those near its tip, in three or four; so that the upper surface seems covered with an irregular mosaic. Granulation of disk fine and even, about 56 grains to a square *mm.*, covering radial shields and the whole disk, above and below; near base of arms, above, are sometimes one or two little naked plates of variable size. Arm-spines short, flat, tapering, rather stout, nine in number; three lowest ones rather longer than the rest, and lowest one longest of all; upper ones about half as long as side arm-plates. Length of uppermost spine, .5$^{m.}$; of lowest one, 1.2$^{m.}$. There are often as many as eleven spines on joints near disk. Tentacle-scales longer than broad, flattened; outside one rather shorter, and cut off more square at the end. Color, in alcohol: above, purplish brown, with upper arm-plates closely speckled with lighter: below, chewing appa-

Fig. 1.



Ophiura teres. (Lower side.)
p, arm-spines.

ratus, lowest arm-spines, and under arm-plates, yellowish white; the rest purplish brown.

Variations. — The mouth-shields may differ somewhat in shape, and the under arm-plates may be light brown. The radial shields are almost always *present*, except in very large specimens. A small specimen had a disk of $14^{mm.}$, and arms of $35^{mm.}$; there were seven or eight arm-spines; most of the upper arm-plates were broken in only two pieces; the color was very dark umber, with fine, sinuous black lines on the disk.

This species at once strikes the eye by its short, rounded arms, covered above by a multitude of irregular pieces. It is distinguished from *O. panamensis*, by broken arm-plates, and proportionately shorter arms; from *O. variegata*, by proportionately shorter arms, granulated side mouth-shields, &c. It most resembles the dark variety of *O. cinerea* (*O. Antillarum* Ltk.) of the West Indies, but differs in having shorter and more rounded arms.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
87	. .	2	Panama.	. . . . .	Alex. Agassiz.	Alcoholic.
88	. .	1	Acapulco.	. . . . .	Alex. Agassiz.	"
			Smithsonian Institution.			
1051	. .	3	Panama.	. . . . .	Rev. T. Powell.	Alcoholic.
1184	. .	1	Panama.	. . . . .	Dr. Sternbergh.	"
1168	. .	1	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"

OPHIOPEZA Peters.

Ophiopeza fallax Peters. Wiegmann's Archiv. 1852, p. 82.

It is a little singular that alcoholic specimens of this genus were brought home by Quoy and Gaimard as early as 1829, but were passed over for twenty-three years, when Dr. Peters described the genus from specimens collected by himself.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
423	. .	. .	. . . . .	. . . . .	Jardin des Plantes, Quoy & Gai., 1829.	Alcoholic.
405	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"
406	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"
407	. .	. .	Zanzibar.	. . . . .	E. Ropes.	"

OPHIARACHNA Müll. & Trosch.

Ophiarachna gorgonia Müll. & Trosch. Syst. Asterid., p. 105.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
395	. .	. .	Zanzibar.	. . . . .	E. Ropes.	Alcoholic.
396	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"
397	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"

OPHIOGLYPHA* Lyman.

Type of the Genus, *O. lacertosa.*

Ophiura Forbes (*non* Lamk.).

Disk covered with unequal, crowded, naked, more or less distorted scales, some of which are swollen. Radial shields naked and swollen. Teeth. No tooth-papillæ. Mouth-papillæ long within, but small and short near the outer end of the mouth-slit, and partly hidden by the scales of the mouth-tentacles. Arm-spines few (commonly three), arranged along the outer edge of the side arm-plates. Tentacle-scales numerous; the innermost pair of tentacle-pores shaped like slits, surrounded by numerous tentacle-scales, and opening diagonally into the mouth-slits. Side arm-plates meeting nearly, or quite, below, but not above. In the back of the disk, where the arm joins it, a notch edged with papillæ. Two genital slits, starting from the sides of the mouth-shields.

GROUPING OF SPECIES HEREIN DESCRIBED.

Arms smooth, tapering, pretty long; three arm-spines; mouth-shields shield-shaped, large,	*O. lacertosa.* *O. Sarsii.* *O. robusta.* *O. Lütkenii.*
Arms slender, smooth; arm-spines short,	*O. albida.*
Arms very short, thick, knotted; arm-spines rudimentary, resembling tentacle-scales; mouth-shields very long and narrow,	*O. nodosa.* *O. Stuwitzii.*
Arms slender; disk-scales mostly small, with a few large ones regularly placed in the centre,	*O. affinis.*

Ophioglypha lacertosa Lyman.

Stella lacertosa Linck. De Stel. Mar., pl. II. fig. 4, p. 47. 1733.
Ophiura texturata? Lamk. Hist. Anim. s. Vert., II. p. 542. 1816.
Ophiura texturata Forbes. Brit. Starfishes, p. 22. 1841.
Ophiura texturata Lütken. Addit. ad Hist. Oph., p. 36.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
56	. .	1	Oresund.	. . . . .	University Museum, Copenhagen.	Alcoholic.
435	. .	. .	Mediterranean.	. . . . .	Jardin des Plantes.	"
393	. .	. .	Conway Bay.	. . . . .	. . . . .	"

* Ὄφις, snake; γλυφή, notch.

Ophioglypha Sarsii Lyman. (Figs. 2, 3.)

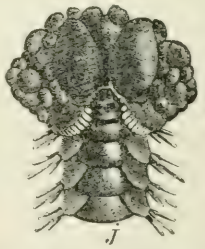
Ophiura acufera Agass. Proceed. Am. Acad., 1851, p. 269. [No description.]
Ophiolepis ciliata Stimps. Inverteb. of Grand Manan. Smithson. Contrib., VI. p. 13. 1854.
Ophiura coriacea Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura arctica? Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura Sarsii Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura Sarsii Lütken. Addit. ad Hist. Oph., p. 42.

Special Marks. — Arms, in the adult, three or four times as long as diameter of disk; longest arm-spine about as long as an arm-joint; primary plates much larger than the intermediate disk-scales.

Description of a Specimen. — Diameter of disk, 17.8$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 8$^{mm.}$; width of arm, without spines, 3.5$^{mm.}$; length of arm, 60$^{mm.}$; distance from outer edge of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 4.6 : 3.4. Mouth-papillæ usually thirteen to each angle of mouth, namely, six on each side, and one at apex of angle; sometimes seven on each side, or again only five; the papilla at the apex points directly to centre of mouth, and is about twice as large as any of the others; it has a diamond or spear-head shape; rest of papillæ small, flat, short, and rather sharp; outer ones smallest; outermost one usually broader and lower than others, being shaped like a cutting edge. Teeth shaped like innermost mouth-papilla, usually four, but sometimes five in number. Mouth-shields longer than broad, bounded by a curve without, an angle within, and laterally by straight lines; length to breadth, 2.4 : 2; length of sides bounding inner angle, 1.4$^{mm.}$; madreporic shield rather smaller and more rounded, with a slight rising in the middle. Side mouth-shields curved, and very long and narrow; starting from inner end of mouth-slits, they follow the sides of the mouth-shield, and meet at its inner point; length to breadth, 2.4 : .6. Under arm-plates covered in good part, even at base of arm, by side arm-plates; all of them, therefore, are much broader than long, and are bounded only by three sides, viz., one outer side nearly straight, and two inner laterals, which are a little re-enteringly curved, and which slope from outer corners of plate towards its middle line, on which they meet in a point; the shape is that of a very short triangle, the point being directed inward. First plate unusually large, nearly oval, length to breadth, 1 : 2; second plate of usual shape, but a little longer than those immediately following, length to breadth, 1 : 2; length of inner lateral, 1.4$^{mm.}$; twentieth plate, .6 : 1.2; plates about two thirds out on arm, .4 : .8; close to tip of arm, plates so covered as to be scarcely perceptible; they are not more than one half or one third the width of the arm, and are bounded by six sides, two outer laterals and two inner laterals, sloping towards

middle line of arm, and meeting to form the outer and inner points of the plate; and two short laterals. Side arm-plates have a large proportionate size to that of other plates; where they meet below, the line of juncture is straight, and this line grows longer as the plates encroach more and more; thus its length, to that of corresponding under arm-plate, is as follows: first joint, .4 : 1; twentieth joint, .8 : .6; about two thirds out on arm, .8 : .4; the upper side of each side arm-plate runs outwards and downwards in a curved line, and overlaps the corresponding upper arm-plate; the outer side runs almost straight downwards to the tentacle-scales, where it makes a little point, and then bends inwards to meet its corresponding plate on the middle line of the arm; the side arm-plates do not meet above till very near the end of the arm. Upper arm-plates, at base of arm, longer than broad, outer side slightly curved, and longer than inner side, so that the lateral sides are sloping; farther out the plates grow proportionately longer, and their outer sides more curved; plates near tip of arm long heart-shaped, the point inward; nearly four plates are included in the incision of the disk; first plate small, triangular, thickened, its point being directed inward, length to breadth, .8 : .8; second plate also small, four-sided, outer side longer, length to breadth, .8 : 1; third plate proportionately wider than second, length to breadth, .8 : 1.4; fourth plate, .8 : 2.2; fifth plate, 1 : 3; sixth plate, 1 : 2.8; length of inner side, $2^{mm.}$; about two thirds out on arm, 1.2 : 1; close to tip of arm, .6 : .4. Disk, above: radial shields large, bounded, and more or less overlapped, along their edges, by surrounding scales; the outer half of their inside edge is free, and bounds the inner portion of the incision in the disk, its outer portion being bounded by radial scales; length to breadth, 3.2 : 2.2; in centre of disk six large, rounded, nearly equal primary plates, central one nearly round, others somewhat oval, their edges overlapped by finer scales about them; diameter of centre plate, $1.6^{mm.}$; in inter-brachial spaces, between central primary plates and edge of disk, three other primary plates, lying in a line at about equal distances; inner one rounded, middle one long oval, outer one, lying on the very edge of disk, rounded; in brachial spaces, one rounded primary plate, lying close to inner ends of radial shields; space between radial shields filled by a very small scale, lying outside, followed by a large scale, and this by two or three very small scales irregularly disposed; rest of disk, above, covered by numerous irregular scales, some as large as primary plates, but most of them varying in length from $.4^{mm.}$ to $1^{mm.}$; disk, below, covered closely with more regular and even scales than those above; near the mouth-shields, in particular, they are of even size, and are regularly imbricated, having an average length of about $.8^{mm.}$. Genital slits edged

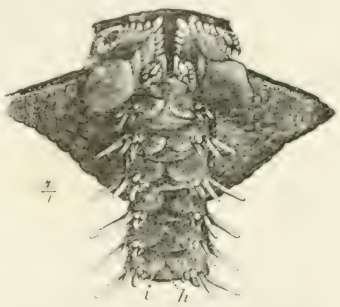
Fig. 2.



Ophioglypha Sarsii.
Upper side, showing the comb of papillæ at the base of the arm. *j*, upper arm-plate.

with very fine, flattened, close-set papillæ, which grow suddenly much larger as they pass upwards along edge of radial scale; whole number about forty; longest ones on radial scales having a length of .6mm. Papillæ running along sides of basal upper arm-plates very small; they start at the inner side of second plate, and run to outer side of fourth plate, there being about four papillæ to each plate; outermost papillæ largest. Arm-spines smooth, rounded, tapering, sharp; second joint, two spines, lengths to that of under arm-plate, .4, .8 : 1; third joint, three spines, .4, .8, 1.2 : 1; all the rest of the joints have exactly three spines, except close to tip of arm; fifth joint, 1.6, 1.6, 1.2 : 1; about two thirds out on arm, 1, 1, 1 : .4; close to tip of arm, middle spine longest, and equal to a little over half the length of the joint; other two spines about equal. Tentacle-scales at base of arm flat and square, and rounded at the corners; in shape much like some of the side mouth-papillæ; mouth tentacles surrounded by a crown of scales, arranged close together in an oval, usually nine on the side next the mouth-shields, and five on the other side; sometimes, however, seven on one side and six on the other; second joint, six scales, three without, and three within the tentacle; third joint, four scales, two without and two within; fourth joint and those just beyond, three scales, two within the tentacle, and one lying between it and middle line of arm; farther out, the last mentioned scale and the one next to it grow smaller and smaller, and finally disappear about three fifths out on the arm, while the third scale maintains its size, and is found quite to the tip of the arm, where it becomes pointed and spear-like. Color, in alcohol: uniform dirty white, or very faint brown; disk above, and chewing apparatus below, a shade darker; color, when dry, chalky white.

Fig. 3.



Ophioglypha Sarsii. (Lower side.)
h, lower arm-plate; *i*, lower part of side arm-plate.

Variations. — A young one has the following characters: diameter of disk, 3.7mm.; length of arms, 9mm. Mouth-papillæ, three on each side, and one at the inner apex of the mouth angle; outer one broadest. First under arm-plate largest of all; plates immediately beyond it small, their length being less than that of the line of juncture of the side arm-plates below. Side arm-plates not meeting above till half way out on the arm. Upper arm-plates proportionately longer than in the adult; two of them are included by the notch in the disk. Arm-spines three; two upper ones nearly as long as arm-joints; lowest one much shorter. There are eleven papillæ, in a close row, along the radial scales and genital slits. The mouth-tentacles have two scales on the side next the

mouth-shield, and one on the other side; the rest of the pores have but one scale. Upper side of the disk almost completely covered by primary plates and radial shields, which are rounded and much swollen; of the primary plates, there is a rosette of six in the centre, and three in each interbrachial space. A larger specimen had a disk of $7^{mm.}$, and arms $24^{mm.}$; and another had the disk $10.5^{mm.}$, arms $42^{mm.}$. The mouth-shields vary somewhat in proportionate length; those of the young have a deeper depression where they touch the inner end of the genital slit. The adult have the disk-scales flatter, and the primary plates and radial shields more conspicuous, by reason of the many small scales between them. Dr. Lütken mentions a variety (*O. coriacea* Ltk.) which has only one tentacle-scale, and the disk-scales very small; and another (perhaps a variety) which has no papillæ on the incision of the disk, arm-spines only half as long as in *O. Sarsii*, and a hairy or felted covering over the surface (*O. arctica* Ltk.). The color of the living animal is a mixture of green, yellow, and gray, with sometimes light bands on the arm (Barrett).

O. Sarsii has been found in Massachusetts Bay, and at the Grand Manan (Stimpson); along the whole coast of Greenland (Holböll, Barrett, &c.); at Spitzbergen, and on the coast of Norway (Sars). It is distinguished from *O. robusta* by the different scaling of the disk; from *O. texturata*, by wanting pores on the under side of the inner arm-joints; from *O. carnea* and *O. albida* by longer arm-spines; and from *O. Lütkenii*, by the double row of notch papillæ, and by their greater sharpness.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
33	. .	12	Grand Manan Island, and Eastport, Me.	. . . . .	Prof. Agassiz.	Alcoholic.
34	. .	2	Eastport, Me.	. . . . .	J. E. Mills.	"
35	41	4	Greenland.	. . . . .	University Museum, Copenhagen.	"
36	. .	1	Greenland.	. . . . .	Prof. Sars, 1852.	"
37	. .	2	Trenton, Me.	. . . . .	A. E. Verrill.	"
38	. .	6	Massachusetts Bay.	. . . . .	. . . . .	Dried.
39	. .	2	. . . . .	. . . . .	. . . . .	"
			Smithsonian Institution.			
1022	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1025	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	"
1023	. .	1	Grand Manan Island.	. . . . .	Wm. Stimpson.	"
1040	. .	12+	Massachusetts Bay.	. . . . .	Wm. Stimpson.	"
1095	. .	1	Coast of Me. and Mass.	. . . . .	Wm. Stimpson.	"

Ophioglypha robusta Lyman.

Ophiolepis robusta Ayres. Proceed. Boston Soc. Nat. Hist., IV. p. 134. 1851.
Ophiura fasciculata Forbes. Appendix to Sutherland's Journal of a Journey.
Ophiura squamosa Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura squamosa Lütken. Addit. ad Hist. Oph., p. 46.

Special Marks. — Mouth-shields nearly heart-shape, broader than long; arms very finely tapering, as long as three or four times the diameter of the disk.

Description of a Specimen. — Diameter of disk, 7.7$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.8$^{mm.}$; width of arm without spines, 1.2$^{mm.}$; length of arm, 32$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2 : 1.8. Mouth-papillæ, seven or eight to each angle of mouth; outermost one broadest, thin, flat, squarish, with a bevelled cutting edge; three innermost ones forming a row at the inner mouth-angle; nearly equal, stout, rounded, pointed; all pointing to centre of mouth. Teeth, five or six, equal, crowded, sharp, flat, with curved sides, like a spear-head. Mouth-shields broad heart-shape, strongly curved without, within pointed, broader than long, length to breadth, 1.2 : 1.5. Side mouth-shields occupying inner sides of mouth-shields, meeting within; long, narrow, but little broader without than within. Under arm-plates broader than long, bounded without by a slightly re-entering curve; on the lateral side, by a very short, nearly straight line; and within by two re-entering curves, converging in a peak; length to breadth (sixth plate), .5 : .7. First plate quite different from the others, being nearly oval; length to breadth, .5 : .8; second plate proportionately longer than those beyond; at tip of arm, plates heart-shape, and extremely minute, compared with size of joint. Side arm-plates strongly developed, meeting below, and there forming a line of juncture, which, at base of arm, is about half as long as an under arm-plate; not meeting above till nearly half-way out on arm. Upper arm-plates diamond-shape, with outer angle rounded, and inner angle truncated, sometimes approaching a hexagonal shape; length to breadth (fifth plate), .7 : .9; first two or three plates rudimentary and irregular, of these usually two are embraced in the notch of the disk; near end of arm, plate heart-shape, with a sharp point inward. Disk scales irregular in shape and size, none very large, very little swelled; primary plates not prominent; near margin of disk about 4 to a square *mm.*; the largest scales have a diameter of .8$^{mm.}$; below, scales very similar, but not quite so large. Radial shields inconspicuous, irregularly triangular, about as long as broad, somewhat overlapped by neighboring

scales; they barely touch without, being separated on the outside by the first upper arm-plate, and within by a large scale; length to breadth about 1 : .7. The row of papillæ along each side of the notch in the disk and the genital slit has about nineteen, of which seven or eight are stout, short, conical, and situated at base of arm; and about twelve are small and flat, and run along genital slit; besides these, there is a row, or irregular group, of from two to seven papillæ standing on each side of the upper arm-plate, just outside the papillæ of the notch. Arm-spines three, rounded, tapering, sharp, rather stout, upper one considerably the largest; lengths to that of under arm-plate (tenth joint), .8, .5, .4 : .5; at tip of arm, the lowest spine is flattened, and has one or two small hooks. Tentacle-scales small, thick, flattened, with a rounded end; those of the mouth-tentacles more rounded; mouth-tentacles with a row of four or five scales on the side next mouth-shields, and three or four on the other; second and third pores with two scales on the inner side, and one or two smaller ones on the outer; pores beyond, only one scale. Color, in alcohol, grayish white.

Variations. — A young one had the following character: diameter of disk, $3^{mm.}$; length of arm, $10^{mm.}$; first under arm-plate triangular, with rounded corners; other plates broad heart-shape, with a point inward. Upper arm-plates separated by side arm-plates; long heart-shape, with a point within, and a clean curve without. Arm-spines more slender than in the adult. In centre of disk an irregular rosette of primary plates. Only one or two papillæ along outer edges of radial shields, and none at all outside of them, on each side of the upper arm-plates. The proportions of the disk to the arms may be as follows: 3 : 10, 6.5 : 24, 6.5 : 25.5, 7.7 : 32, 8 : 30. Lütken also gives 10 : 30 and 7 : 21. It is very easy to get the arms too short, because they taper very finely, and, if the point is broken off, it is not easily detected; thus Dr. Ayres gives the length of the arm (in broken specimens) as but little greater than the diameter of the disk. Sometimes, in well-grown specimens, the basal under arm-plates often touch each other, and the upper arm-spine is proportionately more flattened; these two variations are said not to occur in European specimens. Large individuals have the under and upper arm-plates more angular. The mouth-shields differ in the proportional length, being sometimes regularly curved, or again having two short lateral sides, and an outer curve. The color, in alcohol, is often dark-greenish above, and ash-gray below. According to Dr. Lütken, the living animal is dark gray, reddish, or violet, above; often with greenish arms, barred with dark gray; the radial shields are almost always light, and the mouth-shields commonly have a violet spot.

O. robusta differs from the other species of the genus in its short, broad mouth-shields, and very finely tapering arms. I have examined

many specimens from Massachusetts Bay, Grand Manan Island, Greenland, and Denmark. It is also known from the Faroe Islands, the coast of Norway, Newfoundland, and even from the high latitude of Wellington Channel. It has been taken from low-water-mark (A. E. Verrill) to eighteen fathoms (Lütken). Forbes's remark, that the papillæ at the base of the arm are irregularly arranged, makes it next to certain that this species is his *O. fasciculata.*

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
44	42[a]	4	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
45	42[b]	3	Greenland.	. . . . .	University Museum, Copenhagen.	"
46	. .	7	Phillips' Beach, Mass.	. . . . .	Prof. Agassiz.	"
47	42[a]	5	Oresund.	. . . . .	University Museum, Copenhagen.	"
48	. .	11	Greenland.	. . . . .	Prof. Sars, 1852.	"
49	. .	2	Grand Manan Island.	1860.	A. E. Verrill.	"
50	. .	12+	Massachusetts Bay.	. . . . .	Prof. Agassiz.	Dried.
51	. .	2	Grand Manan.	. . . . .	Wm. Stimpson.	Alcoholic
			Smithsonian Institution.			
1035	. .	2	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1196	. .	2	Coast of Me. and Mass.	. . . . .	Wm. Stimpson.	"

Ophioglypha Lütkenii Lyman.

Ophioglypha Lütkenii Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 197.

Special Marks. — Mouth-papillæ very sharp; no papillæ on the arm outside those along the notch of the disk; papillæ along the notch of the disk flat, thick, blunt, crowded; arms strongly arched above.

Description of a Specimen. — Diameter of disk, 18[mm.]; outer edge of mouth-shield to outer corner of opposite mouth-slit, 8.5[mm.]; width of arm without spines, 3.5[mm.]; length of arm, 90[mm.]; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 4.8 : 3.9. Mouth-papillæ like thorns; a bunch of about ten at the point of the jaw, and two or three scattered ones on each side, placed above the scales of the innermost pair of tentacle-pores. Teeth about nine; long, narrow, flat, rather sharp, arranged sometimes in single, sometimes in double rows. Mouth-shields shield-

shaped, with an angle turned inward, and outer side rounded; lateral corners somewhat projecting; length to breadth, 3 : 3. Side mouth-shields straight, narrow, tapering, meeting within. Under arm-plates, at base of arm, broad, triangular, with lateral corners somewhat rounded; length to breadth, 1 : 2.5; farther out on arm, the plates, as is usual in the genus, grow smaller and smaller, from being encroached on by the side arm-plates. Upper arm-plates much broader than long, and having the outer and inner sides straight and parallel, and nearly equal; outer corners rounded; length to breadth near base of arm, 1.2 : 3.5. Scales of disk, above and below, not arched or swelled, but lying very flat and evenly; primary plates rounded, and conspicuous by their size. Radial shields broad, pentagonal, with outer angles rounded, and a sharp angle directed inward; completely separated by the innermost upper arm-plates; length to breadth, 2.8 : 2. Notches in disk, at base of arms, deep, admitting fully four arm-plates. Comb on the edges of each notch made up of thick, flat, spreading papillæ, crowded side by side, in a continuous line. These papillæ are only six or seven; they decrease in length as they pass under the disk, where they join the narrow, toothed edge that runs along the margin of each genital slit. On base of arm proper, no comb, or line of papillæ. Arm-spines three, tapering, sharp; upper one longest, and equal to about one and a half joints; lowest one shortest, and equal to a little less than one joint. Tentacle-scales of innermost pair of pores short, stout, crowded, flattened; usually four or five on the outer side, and four, somewhat smaller, on the inner side of each pore. Rest of tentacles with only one round and rather thick scale, but there may also be a little tooth, just outside the tentacle. Color, in alcohol: above, bluish gray (a sort of clay color), with darker markings; the arms the same, with darker bands; below, arms whitish; interbrachial spaces of a purplish hue, with white spots.

This species is nearest *O. Sarsii*, but differs in the want of a row of papillæ on the base of the arm, above; in having the papillæ of the arm-comb and of the inner pair of tentacle-pores more crowded and blunter; in the finer and sharper mouth-papillæ, &c.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Smithsonian Institution.			
1039	. .	1	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.

Ophioglypha albida Lyman.

Ophiura texturata, 2 *eadem minor albida* (?) Lamk. Hist. Anim. s. Vert., II. p. 542. 1816.
Ophiura albida Forbes. Wern. Trans., VIII. p. 125.
Ophiura albida Forbes. Brit. Starfishes, p. 27.
Ophiura albida Lütken. Addit. ad Hist. Oph., p. 39.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
52	39ª	3	Faroe Islands.	. . . . .	University Museum, Copenhagen.	Alcoholic.
53	39ᶜ	5	Kattegat and Oresund.	. . . . .	University Museum, Copenhagen.	"
54	39ᵇ	1	Norway.	. . . . .	University Museum, Copenhagen.	"

Ophioglypha nodosa Lyman.

Ophiura nodosa Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura nodosa Lütken. Addit. ad Hist. Oph., p. 48.

Special Marks. — Primary plates irregular in form, but regularly arranged; disk thick; arms often twice the diameter of the disk; arm-spines one, two, or three, separated from the tentacle-scales.

Description of a Specimen. — Diameter of disk, $7^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $4.3^{mm.}$; width of arm without spines, $2^{mm.}$; length of arm, $9.5^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2.9 : 1.5. Mouth-papillæ, ten to each angle of mouth; short, flat, stout, blunt, set close together, those within narrower than the outer ones. Teeth four, remarkably short, resembling mouth-papillæ, flat, stout, with a curved cutting edge. Mouth-shields broader than long, cleanly rounded without, and more or less tapering inwards; length to breadth, 1.6 : 1.2. Side mouth-shields very narrow, occupying only the inner end of mouth-shields; where they meet within, they make an angle, and run still farther inwards, side by side. Under arm-plates rapidly lessening in size towards the tip of the arm; narrow, swollen, rounded without, tapering inwards; first plate largest of all, triangular, with one angle inward, stout, somewhat swollen; length to breadth, .9 : .9; second plate rather smaller, squarish, with rounded corners; beyond this the plates grow more and more rounded

and narrower within. Side arm-plates occuping a large part of the under surface, but not meeting below till about two thirds out on the arm; swollen, thick, rounded, projecting laterally, so as to make vertical creases along the sides of the arm; not meeting above till close to the tip. Upper arm-plates small and swollen, much broader without than within, outer side curved, inner side nearly straight, lateral sides straight; length to breadth (fifth plate), .8 : 1; the first plate is triangular, and very minute; this and the second plate are included by the notch in the disk; at the point of the arm the plates become triangular, with the outer side rounded. The primary plates of the disk are irregular in shape, stout, and swollen, but are regularly arranged; in the centre of the disk, above, there is a close rosette of six; one in the middle, having a diameter of 1.4$^{mm.}$, and five more, rather smaller, ranged about it; there are two more separate ones in each interbrachial space, of which one is just on the margin of the disk; the spaces between the primary plates are filled with closely crowded smaller scales, of various shapes. Radial shields longer than broad, broader without than within, irregular in shape, corners rounded; joined except at their inner ends, where they are separated by a single scale; length to breadth, 1.5 : 1.1. Along the free edge of the radial scale, and so passing downwards and inwards along the whole length of the genital slits, is a close row of about eighteen short, stout papillæ, which are longer and more pointed above, and gradually become very minute below; the longest have a length of about .2$^{mm.}$. Arm-spines near base of arm, commonly one, sometimes two, very short, blunt, and rounded; length about .2$^{mm.}$. The tentacle-scales on the inside of the pores resemble the arm-spines, and near base of arm are four or five in number; those on the outer side are similar, but are a little broader and flatter; on the first three or four pores there are two, then one, and, nearer the end of the arm, none; on each side of the innermost tentacle pore are three, sometimes four, scales, in a close row; they resemble the others, but are rather broader. Color, in alcohol, dull gray.

Variations. — The proportions of the arms to the disk may be 5 : 9, 5 : 10, 6 : 10.5, 7 : 9.5; or, according to Lütken, 6.5 : 16, or 8.5 : 17. There may be either one, two, or three arm-spines, near the base of the arm. This irregularity might be expected in such ill-developed parts.

O. nodosa may be told from *O. Stuwitzii* by its regularly arranged primary plates, and arm-spines separated from the tentacle-scales; the arms also are longer. It has been found on the coasts of Greenland and Newfoundland.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
40	. .	5	Greenland.	. . . . .	Prof. Sars, 1852.	Alcoholic.
41	44	2	Greenland.	. . . . .	University Museum, Copenhagen.	"
42	. .	1	Greenland.	. . . . .	Prof. Sars, 1852.	"
43	. .	1	Greenland.	. . . . .	. . . . .	Dried.
341	. .	7	Straits of Bellisle.	. . . . .	A. S. Packard, Jr.	Alcoholic.
344	. .	12+	Straits of Bellisle.	. . . . .	Williams College.	"
			Smithsonian Institution.			
1033	. .	2	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Ophioglypha Stuwitzii Lyman.

Ophiura Stuwitzii Lütken. Oversigt over Grönlands Echinodermata, p. 51. 1857.
Ophiura Stuwitzii Lütken. Addit. ad Hist. Oph., p. 49.

Special Marks. — Arms very little longer than diameter of disk; disk thick; scales on disk irregularly arranged.

*Description of a Specimen.** — Diameter of disk, 5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 2.5$^{mm.}$; width of arm without spines, 1.5$^{mm.}$; length of arm about 5.5$^{mm.}$. Mouth-papillæ numerous; outer ones very small, inner ones tolerably large, sharp, arranged at the inner point of the jaw in a bunch. Mouth-shields much longer than broad, within pointed, rounded without, lateral sides slightly re-enteringly curved; length to breadth, 1 : .4. Side mouth-shields short and very narrow, meeting within, and occupying the inner angle of the mouth-shields. Under arm-plates very small, swollen, narrow; towards the tip of the arm they become smaller and pentagonal. Side arm-plates large, wider above than below, strongly arched, projecting outward and sideways, so that there is a deep crease between each plate and the one next beyond it. Upper arm-plates broader than long, outer side curved, and longer than inner side, which is nearly straight; lateral sides straight; length to breadth (second plate), .4 : .8; as they go towards the tip of the arm, they grow rapidly narrower, and proportionately longer. Disk scales above, thick, swelled, close, of various shapes and sizes, those towards the centre rather the largest, some

* As the only specimen in the Smithsonian Institution was injured, a part of this description has been taken from Lütken.

having a diameter of 1.2mm.; below, scales more regular, thinner, and, on the average, smaller. Radial shields like the other disk-scales, about as broad as long, irregularly angular or rounded, joined without, separated within by a single scale; length, .6mm. The papilla comb at the base of the arm consists of eight rather stout, flattened papillæ, with rounded ends; the uppermost are the largest, and attain a length of .2mm. The papillæ along the edges of the genital slits are fine, sharp, and scattered. Arm-spines (including tentacle-scales) near base of arm, seven, extremely short and blunt, standing close together; those in the middle a little the longest, though hardly more than .1mm. in length. The tentacle-scales on the inner side of the pores become, in this species, identical with the lower arm-spines; on the outer side of each pore there are, near the base of the arm, several small, stout tentacle-scales. Color, in alcohol, brownish gray.

Variations. — Dr. Lütken gives the proportion of the arms to the disk as 10 to 6.

O. Stuwitzii has been found at Greenland and at Newfoundland. It is distinguished from *O. nodosa* by differently shaped under arm-plates, and an irregular arrangement of disk-scales.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Smithsonian Institution.			
1032	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Ophioglypha affinis Lyman.

Ophiura affinis Lütken. Addit. ad Hist. Oph., p. 45. 1858.
? *Ophiura Normani* Hodge. Trans. Tyn. N. H. Club, Vol. V. Pt. IV. p. 296.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
55	43	3	Oresund.	. . . . .	University Museum, Copenhagen.	Alcoholic.

OPHIOCTEN Lütken.

Disk thick and circular, without notches where the arms join it; partly covered by primary plates and radial shields, between which are fine, close set grains, or small scales, covering the squamous coat; on the interbrachial spaces below, a simple squamous coat, without any covering of grains. A row of papillæ, passing along the genital slits, and upwards, along the margin of the disk, over the arm. Some of the basal upper arm-plates bearing papillæ along their outer edge. Disk cut away at the base of the arm, so as to form a little arch over one or two upper arm-plates which are within the margin of the disk. Side arm-plates meeting below, but not above. Teeth. Mouth-papillæ. No tooth-papillæ. Arm-spines arranged along the outer edge of the side arm-plates. Two genital slits, beginning at the sides of the mouth-shields.

Ophiocten Kröyeri Lütken.

Ophiocten Kröyeri Lütken. Vidensk. Meddelelser. Nov., 1854.
Ophiura sericea? Forbes. Sutherland's Journey.
Ophiocten Kröyeri Lütken. Addit. ad Hist. Oph., p. 52.

Special Marks. — Arms three to four times the length of the diameter of the disk; two upper arm-spines much the longest; papillæ of arm-comb continuous; first, second, and third upper arm-plates bearing papillæ; sometimes, also, the fourth.

Description of a Specimen. — Diameter of disk, $8.7^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $4.2^{mm.}$; width of arm without spines, $1.9^{mm.}$; length of arm, $31^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2.5 : 1.9. Mouth-papillæ, seven or eight to each angle of the mouth; close set, and making an even row; outer one very much the widest, flat, straight, angular; the next two (or three) similar in shape, but much narrower, and more rounded or pointed, innermost one lying directly below teeth, and similar to them, being shaped like a very short, thick, blunt spear-head. Teeth six, set close one above the other, longer than broad, flat, pretty thick, with a blunt point inward; uppermost one narrower than those below. Mouth-shields longer than broad, bounded without by a long, ovoid curve, and within presenting an angle; length to breadth, 1.7 : 1.3. Side mouth-shields meeting within, extremely narrow, but swelling at their outer end into a little knob. Under arm-plates very short, by reason of the

great encroachment of the side arm-plates; bounded without by a gentle curve, and within by two lines a little re-enteringly curved, and converging on the middle line in a slight peak; length to breadth (sixth plate), .3 : 1; sometimes the inner side is bounded by an almost straight line; first plate longer than those beyond, broad triangular, with angles rounded, and one of them directed inward; length to breadth, .7 : .8; second plate of nearly the same shape, but shorter and more rounded. Side arm-plates encroaching below to an unusual degree, so that, at the sixth joint, the length of the line of juncture of the side arm-plates, is to the length of the under arm-plate as .4 : .3; near the end of the arm, almost the whole under surface is occupied by the side arm-plates, the under arm-plates being reduced to little semicircular scales. Upper arm-plates regular, broader than long, narrower within than without, bounded on outer, inner, and lateral sides by straight lines; length to breadth (fourth plate), .7 : 1.4. Disk plates and grains: above, remarkably flat, and closely soldered together, so that their outlines are hard to see; below, the scales are larger, more swollen, and easily distinguishable; in the centre, above, there is a rosette of six large, round, separated primary plates, the largest having a diameter of about 1^{mm}; there are also a few other smaller primary plates in the brachial and interbrachial spaces; of the disk granules there are about 60 to a square *mm.* Radial shields longer than broad, widely separated, irregular, swelled and rounded without; length to breadth, 1.2 : .8. There is a continuous line of short, pointed papillæ, running along the genital slit, and passing along the edge of the disk, over the top of the arm; of these, those along the genital slits are the most slender; the stoutest papillæ are those standing just over the arm, on the sides, about five in number, and having a length of $.2^{mm}$; the four or five lying over the arm, on the middle line, are smaller, and stand a little lower; the first, second, third, and sometimes fourth, upper arm-plates have papillæ along their outer side; of these the first plate has the longest. Arm-spines three, rounded, tapering, very sharp; two upper ones much the longest; lengths to that of under arm-plate (sixth joint), 1.1, .9, .5 : .3. Tentacle-scale triangular, as broad as long, with an angle outward; on the first three or four joints an additional scale on the outside of the pore. Color, in alcohol, light gray.

Variations. — A specimen with a disk $11.5^{mm.}$ in diameter had arms about $36^{mm.}$ long; the color, in alcohol, was brownish white; there were ten or eleven mouth-papillæ, the outer broad one being broken in two or three. The species grows as large as $15^{mm.}$ for the diameter of the disk. It has been taken at Spitzbergen (Professor Kröyer), and on the coast of Greenland, in fifteen to twenty fathoms water, muddy bottom (Barrett).

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
32	45	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
			Smithsonian Institution.			
1036	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.

OPHIOLEPIS Müll. & Trosch.

Type of the Genus, *O. annulosa.*

Disk covered with radial shields and stout scales; each larger one, above, being surrounded by a belt of smaller ones. Over the base of each arm, a small notch in the disk. Genital scales thick and conspicuous. Teeth. No tooth-papillæ. Mouth-papillæ. Side mouth-shields wide, and nearly, or quite, meeting within. Arm-spines arranged along the outer edge of the side arm-plates. Supplementary pieces to the upper arm-plates. Two genital slits, beginning at the sides of the mouth-shields.

GROUPING OF SPECIES HEREIN DESCRIBED.

Two very short arm-spines,	*O. paucispina.*
Five to seven short, even arm-spines,	*O. annulosa.* *O. elegans.*
Four minute arm-spines. Mouth-shields as broad as long,	*O. cincta.* *O. Garretti.*

Ophiolepis paucispina Müll. & Trosch.

Ophiura paucispina Say. Journ. Phil. Acad., V. p. 149. 1825.
Ophiolepis paucispina. Syst. Asterid., p. 90.
Ophiolepis paucispina Lütken. Addit. ad Hist. Oph., p. 102.

Special Marks. — Only two very short arm-spines; arms about twice as long as the diameter of the disk; under arm-plates considerably broader than long.

Description of a Specimen. — Diameter of disk, 5.2$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 2.2$^{mm.}$; width of arm without spines, 1.3$^{mm.}$; length of arm, 13$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.3 : 1.1. Mouth-papillæ, eleven to each angle of mouth; outermost one conical, sharp, partly overlapping the next one, which is swollen, squarish, broader than long, and the largest one of any; the rest even, close set, about as long as broad, a little swollen, and more or less sharp; innermost one pointing to centre of mouth. Teeth, four; uppermost one tapering, narrow, pointed; the rest broad, flat, even, with a curved cutting edge. Mouth-shields longer than broad, bounded without by a long, ovoid curve, and within by two short, re-enteringly curved lines, which meet, to form an angle on the middle line; length to breadth, .7 : .5. Side mouth-shields stout, having, without, a peak which runs to the inner end of the genital slit. Under arm-plates with inner side curved, outer side either evenly or brokenly curved, and lateral sides re-enteringly curved; much broader without than within, in consequence of the outer corners being prolonged laterally like ears or peaks; length to breadth (sixth plate), .4 : .6; first plate much broader than long; bounded without by an outer side and two outer laterals, and having within a little peak which occupies the outer end of the mouth-slit; towards the end of the arm, the plates have the same general form, but are more elongated, and are bounded without by a very obtuse angle, and within by one which is more acute. Side arm-plates conspicuous, and a good deal swollen, meeting both above and below, near end of arm. Upper arm-plates much narrower within than without; four-sided; outer side a little curved, or wavy; inner side nearly straight; lateral sides re-enteringly curved, and sloping strongly inwards towards the middle line of the arm; length to breadth (eighth plate), .4 : .7; towards the end of the arm the plates are nearly triangular, with a point inward; first three plates very short and rudimentary. Supplementary pieces much wider than long, triangular, with their acute angle directed downward; they are found almost to the very tip of the arm; and, where they are largest, extend downwards nearly to the upper arm-spine; occasionally they are broken in two. In the centre of the disk, above, is a conspicuous primary plate, and from this there radiate ten rows of primary plates, two or three in each brachial row, and three or four in each interbrachial row; these plates are angularly round and swollen, and have an average diameter of about .5$^{mm.}$; in addition, there are in each interbrachial space two more radiating rows of rather smaller scales, one lying on each side of the central row of primary plates, between it and the radial shield; all these are completely separated, each from its neighbor, by close single lines of little, thickened, irregular scales, having an average diameter of about .2$^{mm.}$.

Radial shields irregular, rounded, triangular, rather larger than primary plates; length to breadth, .9 : .5; they are separated without by a broadly triangular group of three scales, of which the two outer ones are two or three times as large as the inner one, and within by a group of little scales, in the midst of which stands the outermost primary plate of the brachial row. Interbrachial spaces below closely covered with large scales similar to those above, but rather smaller and flatter; between these there are some little angular scales, which, however, do not completely separate them. Arm-spines two, stout, rounded, tapering, extremely short; length less than .2$^{mm.}$. Tentacle-scales two; near tip of arm only one; stout, thick, set close together, and forming an oval figure. Color, in alcohol: below, whitish; above, yellowish white, with some bands of dark greenish on the arms, and a few markings of the same color on the disk.

Variations. — The arms generally are not more than twice the diameter of the disk in length; the largest specimen I have seen had a disk of 7$^{mm.}$, and arms of 14.5$^{mm.}$. I have seen none smaller than 3.8$^{mm.}$; and this one showed all the adult characters, except that the inside tentacle-scale was not fully developed. The color of the living animal is said to be yellowish, reddish, or grayish, with dark-green arm-bands.

This species has been found by Mr. Riise at St. Thomas, and by Prof. Agassiz and Mr. Wurdeman on the coast of Florida, where Say, also, originally discovered it. It differs from other species in having only two very short arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
204	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
205	. .	2	Florida.	. . . . .	G. Wurdeman.	"
206	55	2	West Indies.	. . . . .	University Museum, Copenhagen.	"
207	. .	1	Cape Florida.	Apr. 1858.	G. Wurdeman.	"
			Smithsonian Institution.			
1162	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1115	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1182	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiolepis annulosa Müll. & Trosch.

Ophiura annulosa De Blainv. (*non* Lamk.). Man. d'Actin., p. 244. 1834.
Ophiolepis annulosa Müll. & Trosch. Syst. Asterid., p. 89. 1842.
Ophiolepis annulosa Lütken. Addit. ad Hist. Oph., II. pl. II. fig. 5.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
203	. .	4	Zanzibar.	. . . . .	G. A. Cheney.	Alcoholic.
402	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"

Ophiolepis elegans Lütken. (Plate II. Fig. 5.)

Ophiolepis elegans Lütken. Addit. ad Hist. Oph., p. 105.

Special Marks. — Arms rather less than three times the diameter of the disk. Primary plates very flat and regular; a rosette of six in the centre of the disk; a single row of three in each interbrachial space, and one primary plate in each brachial space.

Description of a Specimen. — Diameter of disk, 17$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 6$^{mm.}$; width of arm without spines, 4.2$^{mm.}$; length of arm, 48$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 3.6 : 2.9. Mouth-papillæ eleven, close set in an even row; outermost one tapering and sharp, slightly overlapping the next one, which is the broadest of all, being about twice as broad as long; the rest squarish, with bevelled, cutting edges; innermost one pointing to centre of mouth. Teeth four, regularly decreasing in width from below upwards; three lowest ones broad and flat, with a neatly curved cutting edge; uppermost one narrower and more pointed. Mouth-shields much longer than broad, with their outer side curved, lateral sides straight, and inner laterals short, a little re-enteringly curved, and meeting in an angle on the middle line; length to breadth, 2 : 1. Side mouth-shields as broad as mouth-shields, hardly curved, having without a point which runs to the inner end of the genital slit. Under arm-plates broader than long, a trifle narrower within than without, squarish, with rounded corners, outer and inner sides nearly straight, lateral sides a little re-enteringly curved; length to breadth (seventh plate), 1 : 1.6; towards the end of the arm, the plates are broader with-

out than within, bounded within by a short, straight inner side, and two inner laterals; on the lateral sides by slightly re-entering curves, and without by a curved or wavy outer side; these plates somewhat resemble the *basal* plates of *O. paucispina;* first plate much broader than long, nearly oval, with an inward projection filling the end of the mouth-slit. Side arm-plates very regularly arched, occupying a portion of the under surface of the arm more than equal to the width of the under arm-plates. Upper arm-plates regular, broader than long, bounded without and within by straight lines, and laterally by short curves; length to breadth (fourth plate), 1 : 2; farther out they become regularly hexagonal, and, at the tip of the arm, fan-shape. Supplementary pieces, long triangular, with their point downward; length to breadth (seventh joint), .5 : 1. The arrangement of the upper plates of the disk is extremely regular, and is as follows: in the centre a rosette of six angular primary plates, of which the central one is the smallest, the others having a diameter of about $2^{mm.}$; from this group radiate five interbrachial rows, each of three primary plates; in the brachial spaces there is a single primary plate, between the inner ends of the radial shields and the central rosette; each primary plate is surrounded by a single line of about eighteen small angular scales, lying on the same level with the larger plates. Radial shields pear-seed shaped, their points inwards; large, somewhat swollen; widely separated, without, by a broad triangle of three scales, of which the two outer ones are rounded and much swollen, and within by a large scale, with its belt of smaller ones; a part of the above-mentioned primary plate also lies between the inner ends of the radial shields; their length to breadth is 3.2 : 2.2. Interbrachial spaces below covered without by a triangle of three very large, much swollen scales, and within by three cross rows of smaller and flatter scales; the outer genital plate is much enlarged, and makes a conspicuous ridge. Arm-spines, near base of arm, six; farther out, five; very short, rounded, and blunt, scarcely tapering; lengths to that of under arm-plate, .3 (or .4) : 1. Tentacle-scales two, forming together a nearly oval figure; on the outer side of each pore there is a stout triangular piece, that may be considered as homologous with a similar part often found in *Ophioglypha;* besides this there is on the basal pores a minute edge attached to the lateral side of the under arm-plate. Color, in alcohol: below, pure white; above, disk clouded with pale greenish-gray and white, many of the primary plates surrounded by a line of fine brown specks; arms alternating with bands of darker and lighter greenish-gray, the upper surface of the side arm-plates being in the latter bands white.

Variations. — The above description was taken from a Florida specimen; three dried ones, from Charleston, S. C., seem to belong to the

same species; they present no structural variation, except that sometimes there are three instead of two large scales, in a straight line, between the radial shields; the largest specimens have the disk to the arms, as 21 : 58. The supplementary arm-plate pieces are sometimes cut in two. Drawings belonging to Professor Agassiz show that the living animals (from Charleston) vary in color; in one, the upper surface of the disk is vandyke brown, the central primary plate being light yellow, and the other primary plates surrounded by specks of white or of brown; the upper arm-plates are like the disk, and bear specks of white; the side arm-plates yellow; in another, there is a large, oblong, light-yellow spot in the middle of the disk, and a smaller round spot in each interbrachial space, all these being limited by black dots; the rest of the disk is mottled with brownish and greenish gray, and some black dots; the side arm-plates are light yellow, and the upper arm-plates lighter or darker greenish-gray, making bands. Occasionally one or two of the lower teeth are split in two.

This species is distinguished by its regular back plates, and numerous arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
208	. .	1	Florida.	. . . . .	G. Wurdeman.	Alcoholic.
209	. .	2	Charleston, S. C.	. . . . .	Prof. Agassiz.	Dried.
210	. .	1	Charleston, S. C.	. . . . .	Prof. F. S. Holmes.	"

Ophiolepis cincta Müll. & Trosch.

Ophiolepis cincta Müll. & Trosch. System der Asteriden, p. 90.
Ophiolepis cincta Lütken. Addit. ad Hist. Oph.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
400	. .	. .	Zanzibar.	. . . . .	C. Cooke.	Alcoholic.
401	. .	. .	Society Islands.	. . . . .	A. Garrett.	"

Ophiolepis Garretti LYMAN. (Pl. II. fig. 4.)

Special Marks. — Arms six times the diameter of the disk, not tapering till just at the end; mouth-shields as broad as long.

Description of a Specimen. — Diameter of disk, $9^{mm.}$; width of arm, without spines, $2^{mm.}$; length of arm, $55^{mm.}$. Mouth-papillæ, five on each side, and one under the teeth, those on the sides flat, stout, squarish, crowded; the outer one sends a slender prolongation above and beside the next papilla. Teeth regular, broader than long, with a rounded cutting edge. Mouth-shields neatly rounded without, and with an acute angle within; length to breadth, .9 : 1; their outer edge is bordered by a line of little, crowded, angular pieces, one of which is inserted between the mouth-shield and side mouth-shield, at each corner. Side mouth-shields large, of equal width along their length; within separated by one or two supplementary pieces. Under arm-plates longer than broad, broader without than within; outer side curved, lateral sides re-enteringly curved; length to breadth (seventh plate), .9 : .7. Side arm-plates thick and swelled. Upper arm-plates broader than long, broader without than within, swelled; length to breadth (ninth plate), .5 : 1.3. The supplementary pieces are small and crowded, the one at each outer corner being largest; they are at the base of the arm, from seven to ten. The scaling of the disk is very regular, the scales being a little smaller below than above; diameter of the largest nearly $1^{mm.}$; each has its free edge bordered by a line of crowded and regular pieces, which are commonly about seven in number. Radial shields irregular oval, separated by two large scales, one outside the other, and two smaller ones lying side by side. Arm-spines four, very small and slender, confined to the middle of the edge of the side arm-plate; lowest one longest, $.5^{mm.}$ long. Tentacle-scales two, rarely three, stout, thick, forming together an oval figure, which stands obliquely to the length of the arm. Color, in alcohol: disk, pale reddish-yellow, with bands of darker on the arms; below, grayish. The living animal has a brick-red disk, with paler bands on the arms; the lower surface much paler (Garrett).

This species is distinguished from *O. cincta* by shorter mouth-shields and much longer arms. The best distinguishing mark, however, is the microscopic appearance of granulation which the upper arm-plates have, while in *O. cincta* they are smooth and glossy.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
331	. .	1	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.

OPHIOCERAMIS* Lyman.

Ophiolepis Müll. & Trosch., *pars.*

Disk covered with radial shields and stout scales, none of which are surrounded by a belt of small ones. Over the base of each arm, a small notch in the disk. Genital scales concealed. Teeth. Tooth-papillæ. Mouth-papillæ. Side mouth-shields small, and not meeting within. Arm-spines arranged along the outer edge of the side arm-plates. No supplementary pieces to the upper arm-plates. Two genital slits, beginning outside the mouth-shields.

Ophioceramis Januarii Lyman.

Ophiolepis Januarii Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiolepis Januarii Lütken. Addit. ad Hist. Oph., p. 108.

Special Marks. — Arms four and a half or five times the diameter of the disk, which grows as large as 19$^{mm.}$. Three (sometimes four) arm-spines, the middle one longest; all of them stout, tapering, and flattened.

Description of a Specimen. — Diameter of disk, 19$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 7.5$^{mm.}$; width of arm without spines, 4.5$^{mm.}$; length of arm, about 82$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2.8 : 3.6. Mouth-papillæ four on each side, small, rounded, flattened, and close set; outermost one sharp, and over-

* Ὄφις, snake; κεραμίς, tile.

lapping the second, which is the largest of all; the space below the tooth-papillæ is commonly vacant, but is sometimes occupied by two very small mouth-papillæ. Tooth-papillæ two; narrow, long, and a little curved, touching each other below, but diverging upwards, leaving a triangular space, which is filled by the lowest tooth.* Teeth ten, flattened, squarish, with a wavy cutting edge, which is re-enteringly curved, and thickened at its middle point; lowest one more or less modified by the two tooth-papillæ; the next four of even width, and broader than the five uppermost ones. Mouth-shields rounded, about as long as broad, with a curve within and a rounded angle without; length to breadth, 1.8 : 1.6. Side mouth-shields irregular, and very small. Under arm-plates much broader than long, broader without than within; outer and inner sides curved; lateral sides strongly re-enteringly curved; outer corners prolonged laterally, as little peaks; length to breadth (eighth plate), 1.1 : 2.2; first plate very small, rounded diamond-shape; breadth $1^{mm.}$; towards the end of the arm the plates become proportionately much longer, but the curves of their sides remain about the same. Side arm-plates not encroaching above or below; considerably thickened along their outer edge, to afford a base for the strong arm-spines. Upper arm-plates much broader than long; broader without than within, with outer corners well rounded; they are divided on the middle line into two quite distinct pieces, very rarely into three or even four pieces; the two or three first plates are short and rudimentary, and are enclosed by the notch in the disk. Disk-scales closely overlapping; in the centre a circular, primary plate, about $1.5^{mm.}$ in diameter; four primary plates may be indistinctly seen in each interbrachial, and three in each brachial space; on the interbrachial spaces below, the scales are narrow, close, small, and even, having an average length of about $.7^{mm.}$; at the base of each arm, there are very fine scales, which often run out a little way on the side of the arm, much as in *Ophiura*. Arm-spines three (near base of arm, sometimes four), stout, strongly tapering, rounded, a good deal flattened; middle one longest; lengths to that of under arm-plate (thirteenth joint), 1.7, 2.5, 2 : 1.1; the upper spine often is suddenly enlarged at the base. Tentacle-scales small, rounded, flattened, a little longer than broad, standing close together; near the base of the arm there are two outside and two inside each pore; but farther out the two outer ones become smaller and smaller, and are soon reduced to a little edge, lying along the lateral side of the under arm-plate. Color, in alcohol: yellowish vandyke-brown, above; below, the same, but lighter and more yellowish.

* These might almost as well be termed *mouth-papillæ*, except that they do not lie quite on a level with the rest. The innermost papillæ in *Amphiura* are similar, but descend, so as to form part of the row of mouth-papillæ, among which they are included.

This large and very characteristic species has been taken at Rio Janeiro by Professor Kröyer.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Smithsonian Institution.			
1026	. .	1	Rio Janeiro.	. . . . .	University Museum, Copenhagen.	Alcoholic.

OPHIOZONA* Lyman.

Ophiolepis Müll. & Trosch., *pars.*

Disk covered with radial shields and stout scales, each larger one, above, being surrounded by a belt of smaller ones. Over the base of each arm, a small notch in the disk. Genital scales thick and conspicuous. Teeth. No tooth-papillæ. Mouth-papillæ. Side mouth-shields wide, and nearly, or quite, meeting within. Arm-spines arranged along the outer edge of the side arm-plates. No supplementary pieces to the upper arm-plates. Two genital slits, beginning at the sides of the mouth-shields.

GROUPING OF SPECIES HEREIN DESCRIBED.

Arm-spines nearly as long as arm-joints; lowest ones longest,	*O. impressa.*
Arm-spines very short, and of equal lengths,	*O. pacifica.*

Ophiozona impressa Lyman. (Fig. 4.)

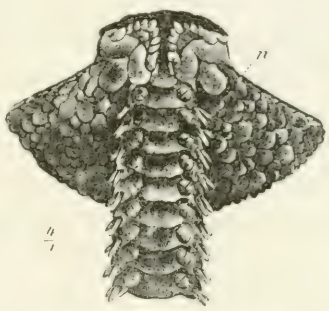
Ophiolepis impressa Lütken. Addit. ad Hist. Oph., p. 101.

Special Marks. — Arms four or five times the diameter of the disk. Five moderately stout arm-spines; the two lowest longest, and nearly as long as the arm-joints. Disk-scales overlapping, the larger ones nearly circular.

* Ὄφις, snake; ζώνη, belt.

Description of a Specimen. — Diameter of disk, 15.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 6$^{mm.}$; width of arm without spines, 3.1$^{mm.}$; length of arm, 64$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2.5 : 3.3. Mouth-papillæ eleven; outermost one slender, tapering, sharp, overlapping the next to it, which is broader than long, and stout; rest of papillæ short, stout, pointed, somewhat rounded; the whole form a close, even row. Teeth five or six, regularly decreasing in width, from below upward; short, flat, regular, with a curved cutting edge. Mouth-shields longer than broad, bounded without by a long, ovoid curve, and within by two short lines, which are a little re-enteringly curved, and meet to form an angle on the middle line; length to breadth, 1.4 : 1. Madreporic shield with a deep, round depression. Side mouth-shields thick, swollen, slightly curved, having a little peak without, running up to the inner end of the genital slit. Under arm-plates squarish, small, bounded without by a slight curve, within and on the lateral sides by re-entering curves; outer corners projecting; length to breadth (eighth plate), 1 : 1.5; first plate shaped like the segment of a circle, with the curve outward, and having a little projection within, occupying the outer end of mouth-slit; towards the tip of the arm, the plates are proportionately longer, but have the same general outline. Side arm-plates pretty large, and occupying a good deal of upper and under surfaces of the arm, but not meeting either above or below, even near its tip. Upper arm-plates broader than long, broader without than within; outer side slightly curved, inner and lateral sides straight, outer corners cleanly rounded; length to breadth (seventh plate), 1 : 2; first two or three plates enclosed by notch in disk, and modified in breadth accordingly, short, thin, rudimentary; length to breadth of third plate, .6 : 1.8; towards tip of arm, the plates are quadrangular, but with so short an inner side as to be almost wedge-shape. In the centre of the disk, above, a rosette of six separated, nearly circular primary plates, having a diameter of about 1$^{mm.}$; in each interbrachial space, above, five radiating rows of similar separated plates or scales, the middle row being composed of four primary plates; between all these are numerous little scales, having a diameter usually of .5$^{mm.}$, and arranged usually in single lines. Radial shields pear-seed shaped, the point inward; length to breadth, 2.2 : 1.4; widely separated without by a triangle of three large round scales, and within by a single large oval scale, between which and the triangle are

Fig. 4.



Ophiozona impressa. (Lower side.)
n, genital scales.

several smaller scales; scales of interbrachial spaces below, smaller and thinner than those above. Arm-spines five, short, moderately stout, tapering, rounded, uppermost one shortest, two lowest ones rather the stoutest; lengths to that of under arm-plate (seventh joint), .6, .7, .7, .9, .9 : 1; near end of arm, only three spines; and even near its base, there are often only four. Tentacle-scales two, stout, longer than broad, set close to each other, and forming together an oval. Color, in alcohol: above, disk-scales and arm-plates vandyke-brown, some of them edged or mottled with white; arms irregularly banded with burnt umber; below, arms and mouth parts faint yellowish-brown; interbrachial spaces nearly white, with a tinge of greenish.

Variations. — The larger disk-scales are in some specimens more prominent and distinct than in others; occasionally there are only three, instead of five, radiating rows of larger scales, in each interbrachial space above. The color, in alcohol, varies a little in intensity. The proportions of the arms to the disk may be as 9.2 : 36, 11 : 41, 12.5 : 66, 13.2 : 51, 14 : 57, or 15.5 : 64.

O. impressa has been taken at St. Thomas, in from one to four feet of water, on a sandy bottom, or on corals (A. H. Riise); also on the coast of Florida (Professor Agassiz, Mr. Wurdeman). It may be distinguished from *O. pacifica* by having longer arm-spines, which are not of equal lengths.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
212	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
213	54[b]	2	West Indies.	. . . . .	University Museum, Copenhagen.	"
214	. .	1	Florida.	. . . . .	Prof. Agassiz.	Dried.
			Smithsonian Institution.			
1080	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1085	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1099	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
1161	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophiozona pacifica LYMAN.

Ophiolepis pacifica LÜTKEN. Vidensk. Meddelelser. Jan., 1856.
Ophiolepis pacifica LÜTKEN. Addit. ad Hist. Oph., p. 104.

Special Marks. — Arms three or four times the diameter of the disk. Arm-spines four or five, very small, and of even length.

Description of a Specimen. — Diameter of disk, 4.7$^{mm.}$; from outer side of mouth-shields to outer corner of opposite mouth-slits, 2.3$^{mm.}$; width of arm without spines, 1.1$^{mm.}$; length of arm, 18$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.1 : 1. Mouth-papillæ, eleven to each angle of mouth, small, close set, flat, angular, squarish; outermost one somewhat pointed, and slightly overlapping its next neighbor, which is much the largest of all. Teeth four, flat, broad, with a curved cutting edge; uppermost one narrowest. Mouth-shields much longer than broad, bounded by an ovoid curve without, and by an angle within; length to breadth, .6 : .4. Side mouth-shields swollen, triangular, large; running out, with one corner, to the head of the genital slit. Under arm-plates broader than long, broader without than within; outer and inner sides strongly re-enteringly curved; length to breadth (sixth plate), .4 : .6; first plate nearly oval, as broad as the following plates, with a projection within filling the outer end of the genital slit; at the tip of the arm the plates are sharp wedge-shaped. Side arm-plates occupying a good deal of upper and under surface, but not meeting above and below till about two thirds out on the arm. Upper arm-plates very regular, a good deal broader without than within, four-sided, the sides almost perfectly straight; length to breadth (sixth plate), .4 : .8; the notches in the disk are so shallow that only one rudimentary plate is admitted. In the centre of the disk, above, is a large, nearly round, primary plate, .6$^{mm.}$ in diameter, surrounded by five little triangular scales; outside these is a circle of five large oval plates, one in each brachial space; the interbrachial spaces have three radiating rows of plates, those of the central row being the largest; there are also a few very small scales scattered among the others. Radial shields sunken, irregular, longer than broad, running to the edge of the disk, separated by a single row of three scales; their outer ends bounded by two large, narrow, curved scales; length to breadth, .9 : .6. Interbrachial spaces, below, covered with nearly equal scales, with some little ones among them; genital slits bordered by three narrow scales, of which the outer one is longest and widest. Arm-spines four, very small, of even length, cylindrical, tapering, about one third as long as

the arm-joints. Tentacle-scales two, lying obliquely, and forming together a very regular oval. Color, in alcohol: white, with a few light-grayish bars on the arms, and cloudings of the same tint on the disk.

Variations. — The above description was taken from a young specimen. According to Dr. Lütken, the adult has a disk of $10^{mm.}$, and arms of 30 or $40^{mm.}$. There are five arm-spines also.

O. pacifica has been found at Puntarenas (Dr. Örsted) in one fathom water, and at Panama (Alex. E. R. Agassiz). It differs from *O. impressa* in the smallness and regularity of the arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
211	. .	1	Panama.	. . . . .	Alex. Agassiz.	Alcoholic.

OPHIOPLOCUS* Lyman.

Disk closely and finely scaled above and below. Genital scales hidden. Teeth. No tooth-papillæ. Mouth-papillæ. Side mouth-shields wide, and nearly, or quite, meeting within. Arm-spines arranged along the outer edge of the side arm-plates. Upper arm-plates divided on the middle line into halves, which at the base of the arm are placed at the outer lower corner of the joint, on each side being separated by a number of supplementary pieces. At the tip of the arm the plate is simple; then it divides in two, and the halves are gradually forced apart by the intrusion of supplementary pieces. Two short genital slits, extending only half-way to the margin of the disk, and beginning outside the mouth-shields.

* Ὄφις, snake; πλόκος, a twisted rope.

Ophioplocus imbricatus Lyman.

Ophiolepis imbricata Müll. & Trosch. System der Asteriden, p. 93.
Ophioplocus tessellatus Lyman. Proc. Boston Soc. Nat. Hist., VIII. p. 76. 1861.

Special Marks. — Color gray, with obscure cross-bands on the arms; length of arms, in adults, four to five and a half times the diameter of the disk.

Description of a Specimen. — Diameter of disk, $17^{mm.}$; width of arm without spines, $3.5^{mm.}$; length of arm, $70^{mm.}$; mouth-papillæ, five on each side, and one odd one, placed just under the teeth; the side papillæ squarish, flat, and crowded, the odd one resembling the teeth. Teeth five, thick, short, stout, broader than long, with a curved cutting edge. Mouth-shields broad heart-shape, with a curve without and an angle within; length to breadth, 1 : 1.5. Side mouth-shields large, and of even width, $.5^{mm.}$ wide. Under arm-plates squarish, very regular and clear in outline, slightly separated, thick; outer side curved, lateral sides a little re-enteringly curved; length to breadth (tenth plate), 1 : 1.3. The halves of the upper arm-plates are rounded triangular, very much like the supplementary pieces in *Ophionereis;* at the base of the arm they lie very low down, so that the side arm-plates are much reduced in size; they are separated from each other by six supplementary pieces, of which one lies on the middle line of the arm, and the other five make a sort of semicircle round it; at the base of the arm the central piece of this semicircle becomes very small indeed, and is often divided in two; between the supplementary pieces there are sometimes single large grains. The halves of the upper arm-plates and the supplementary pieces are thick and swelled, and often of about the same size. Side arm-plates small, and almost covered up by the arm-spines. Scales of the disk a little larger above than below, mostly overlapping, but with here and there a round scale, varying somewhat in size, the largest $.8^{mm.}$ long. Radial shields very small, about $1^{mm.}$ long, sunken in the scaling of the disk. Genital slits only $2^{mm.}$ long, starting $1^{mm.}$ outside the mouth-shield. Arm-spines three, stout, round, blunt; the lowest much the largest; lengths to that of under arm-plate, .8, 1, 1.3 : 1. Tentacle-scales two, longer than broad, flat, nearly oval. Color, in alcohol: gray, with very obscure cross-bars of darker on the arms. According to a colored sketch by Mr. Garrett, the tints of the living animal are about the same.

Variations. — The characters of fifteen specimens which I have examined were very uniform, only the young have shorter arms. The proportions of the disk to the arms in specimens of different sizes

was 9.5 : 30, 16 : 68, and 19 : 93. The radial shields vary a little in size and distinctness.

I have satisfied myself that this is the same species as the *Ophiolepis imbricata* of Müller & Troschel, whose imperfect description at first led me to describe it as new.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
328	5	1	Kingsmills Islands.	. . . . .	A. Garrett.	Dried.
329	. .	12+	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.
408	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"

OPHIOCOMA Agassiz.

Type of the Genus, *O. scolopendrina* Agass.

Disk granulated. Radial shields covered. Teeth, tooth-papillæ, and mouth-papillæ. Spines, usually from four to six; smooth; arranged along the sides of the side arm-plates. One or two tentacle-scales. Two genital slits, beginning outside the mouth-shields.

NOTE ON SOME SPECIES OF THE GENUS OPHIOCOMA.

Ophiocoma dentata Müll. & Trosch., of which the original is in the Berlin Zoölogical Museum (No. 931), is not a good species, and seems only a middling sized *Ophiocoma echinata*. The species described by Dr. Lütken as *O. dentata* is quite another thing, and seems to be *O. brevipes* (Addit. ad Hist. Oph., p. 165).

Ophiocoma variabilis Grube (Acad. Cæs. Nova Acta, 1860) is, according to the plate and the description, only a partly grown specimen of *O. Schœnleinii*, or of some allied species. *O. Schœnleinii* itself is rather a dubious species. The originals at Berlin (Zoöl. Mus., No. 930, and Anatom. Mus., 11561) look like some varieties of *O. erinaceus*, the chief difference being that most of the tentacle-pores have but one tentacle-scale. The same doubts may be raised about *O. Wendtii* (Berlin Zoöl. Mus., No. 929), whose chief distinguishing marks are the absence of the second tentacle-scale on most of the joints, and the peculiar form of the basal under arm-plates. It may turn out that *O. Wendtii* and *O. Schœnleinii* are the same species.

Ophiocoma tumida Müll. & Trosch. The original, in the Leyden Museum, is marked "Gulf of Genoa"; but this looks like a mistake. I do not remember to have seen any *Ophiocoma* at all from the Mediterranean, much less one which in size and appearance closely resembles *O. echinata*. *O. bidentata* Müll. & Trosch. is plainly a worthless species, and *O. Nilssonii* Müll. & Trosch. probably goes in the same category.

GROUPING OF SPECIES HEREIN DESCRIBED.

- One tentacle-scale,
  - *O. Valenciæ.*
  - *O. pumila.*
  - *O. Alexandri.*
  - *O. Riisei.*
  - Near base of arm, sometimes two tentacle-scales, *O. æthiops.*
- Two tentacle-scales,
  - Arm-spines about equal, *O. nigra.*
  - Upper arm-spines longest,
    - *O. echinata.*
    - *O. erinaceus.*
    - *O. scolopendrina.*
  - Lowest arm-spine longest, *O. insularia.*
  - Six slender arm-spines; disk and arms lined and spotted, *O. pica.*
  - Disk granulation very fine and close; spines regular, *O. brevipes.*

Ophiocoma Valenciæ Müll. & Trosch.

Ophiocoma Valenciæ Müll. & Trosch. Syst. Asterid., p. 102.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
306	. .	4	Zanzibar.	. . . . .	G. A. Cheney.	Alcoholic.
357	. .	. .	Mozambique.	. . . . .	C. Cooke.	"
356	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"

Ophiocoma pumila Lütken.

Ophiocoma pumila Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiocoma placentigera Lütken. [Labelled specimens.]
Ophiocoma pumila Lütken. Addit. ad Hist. Oph., p. 146.

Special Marks. — Commonly five arm-spines; first or second spine longest.

Description of a Specimen. — Diameter of disk, 13$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 5$^{mm.}$; greatest width of arm without spines, 2.2$^{mm.}$; length of arm about 75^{mm}; distance from outer edge of mouth-shields to inner point of tooth-papillæ, to that between outer corners of mouth-slits, 2.5 : 2.5. Mouth-papillæ short, stout, longer than broad, much rounded, often nearly egg-shaped, somewhat irregularly disposed; innermost one more pointed and tooth-like; about fourteen to each angle of mouth. Tooth-papillæ

about twelve, in four irregular horizontal rows; stout, rounded, a little longer than broad, pretty closely set. Teeth four, longer than broad, flat, square, inner edge narrower than outer edge; two middle ones largest, upper one much narrower than others. Mouth-shields rounded square, a little longer than broad; length to bre. lth, 1.5 : 1.3. Side mouth-shields extremely small, variable in size, occupying a triangular space between outer part of mouth-shield and innermost arm-plate. Under arm-plates more or less octagonal, those lying within the margin of disk smaller than those just beyond. Innermost plate rudimentary, scarcely larger than mouth-papillæ next it; second plate nearly square, with outer corners rounded, length to breadth, .8 : .8; next three plates nearly regular octagons; eleventh plate slightly curved without, lateral sides straight, inner laterals rather longer than inner side proper, length to breadth, 1.1 : .9; this is the common shape of the under arm-plates, and is retained till very near the tip of the arm. Side arm-plates encroaching somewhat on both upper and under arm-plates. Upper arm-plates very broad heart-shaped, outer side and corners regularly curved, inner laterals sloping towards each other, and nearly meeting within. First plate rudimentary, and nearly covered by granulation of disk; second, third, and fourth plates more or less oval, and all smaller than those that immediately succeed; sixth plate of usual shape and size, length to breadth, 1.2 : 1.7; this proportion holds the same (though the plates grow smaller) close to the tip of the arm. Granulation of upper surface of disk rather coarse, grains shaped like mouth-papillæ, some longer than their neighbors, about 30 to a square *mm.* Granulation extended on arm so as nearly to cover first upper arm-plate; below, a broad naked belt parallel with genital slits; remaining triangular space granulated, quite up to mouth-shields; grains less close and rather more tooth-like than those above. Edges of genital slits more or less finely toothed. Arm-spines neatly rounded and tapering, slightly flattened. Second and third joints, three slender flattened spines, about .7$^{mm.}$ long; fourth and fifth joints, four spines, about 1.2$^{mm.}$ long; sixth, seventh, eighth, and ninth joints, five spines; tenth joint, four spines, decreasing in length and thickness from above below; length of upper spine to that of lowest, 2 : 1.3; two upper spines considerably stouter than two lowest. This number and proportion holds till near the tip of the arm; the spines grow more slender, however, and the second is sometimes longer than the upper one. Close to tip of arm only three spines. Tentacle-scales pointed oval, like a broad spear-head; on second, third, and fourth joints two, on rest only one. Color, in alcohol: above, vandyke brown, paler towards centre of disk; arms banded with lighter, each band occupying two or three joints; also some white spots on edges of upper arm-plates; below, very faint brown; chewing apparatus, mouth-shields, and under arm-plates nearly white, the latter often with

a light-brown pattern; under arm-spines nearly white; upper spines pale brown at their base, lighter at the point.

Variations. — A specimen with a disk 15$^{mm.}$ had arms 75$^{mm.}$; uniform vandyke-brown above, and same below, but paler, with a few spots and bands near end of arms and on under arm-plates; mouth-shields a little broader than long, and nearly circular; granulation of disk in interbrachial spaces below reaching nearly to genital slits on either side; two or three of side mouth-papillæ soldered together, making one broad one; only three rows of tooth-papillæ; five joints each with two tentacle-scales, rest with only one. A specimen with a disk of 16$^{mm.}$ had arms of 115$^{mm.}$, which shows a range of length, in grown specimens, of from five to seven times. Lütken gives the length as over eight times the diameter of the disk. — *Young*, said to be this species (original *O. pumila* Ltk.): diameter of disk, 2.5$^{mm.}$; length of arms, 12.5$^{mm.}$; disk covered with fine scales, over which are scattered a few grains, or rather short spines. Upper arm-plates long heart-shaped, i. e. bounded without by a strong curve, and on sides by two straight lines, meeting within. Side arm-plates meeting above and below. Under arm-plates longer than broad, outer side curved, laterals re-enteringly curved, inner laterals straight, and meeting within. One tentacle-scale. Only two tooth-papillæ. Mouth-shields heart-shaped, longer than broad. Arm-spines four, at base of arm; rather more slender than in adult, and a little rough. Color, in alcohol: pale yellowish-brown above, arms barred with whitish, and six in number.

This species is distinguished from the more common type of *Ophiocoma*, by its long flattened arms, and less robust structure.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
291	. .	2	Florida.	. . . . .	Prof. Agassiz.	Alcoholic.
292	. .	1	Tortugas, Fla.	Apr. 22, '58.	J. E. Mills.	"
293	. .	1	Tortugas, Fla.	Mar. 19, '58.	J. E. Mills.	"
294	. .	1	Key West, Fla.	Jan. 28, '58.	J. E. Mills.	"
295	. .	3	Cape Florida.	. . . . .	G. Wurdeman.	"
296	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
297	. .	2	Jeremie, Hayti.	. . . . .	Dr. D. F. Weinland.	"
298	62[a]	2	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
299	62[b]	1	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
			Smithsonian Institution.			
1050	. .	1	Florida.	. . . . .	. . . . .	Alcoholic.
1091	. .	1	St. Thomas, W. I.	. . . . .	Univ.Mus.Cop'hagen.	"
1163	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1075	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1102	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.

Ophiocoma Alexandri Lyman.

Ophiocoma Alexandri Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 256. 1860.

Special Marks. — Grayish or yellowish brown. Arms banded; five to seven spines; third or fourth spine longest.

Description of a Specimen. — Diameter of disk, 17$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 5.5$^{mm.}$; width of arm without spines, 3.3$^{mm.}$; length of arm, 120$^{mm.}$; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 2.7 : 3. Mouth-papillæ flat, rounded, of nearly equal size, rather small; nine or ten to each angle of mouth. Tooth-papillæ bead-like, crowded, most of them in two vertical rows; about nine in number, the upper middle one larger than the others. Teeth three or four, stout, flat, a little tapering. Mouth-shields nearly round, with inner end slightly truncated; length to breadth, 1.6 : 1.6. Side mouth-shields very narrow and small, occupying the inner part of mouth-shield, but not meeting within. Under arm-plates very regular, not overlapping, rounded octagonal, inner angles less rounded than outer; the plates within the disk a good deal smaller than those beyond; length to breadth (twentieth plate), 1.2 : 1. Side arm-plates encroaching somewhat above. Upper arm-plates regular; oval heart-shape, with the point inward; outer corners very cleanly curved, outer side nearly straight; length to breadth (ninth plate), 1.2 : 2.2. Near tip of arm, the plates are regular heart-shape, with an acute point turned inward. Grains of disk elongated so as to form short spines, like grains of wheat, of different sizes; about 25 to a square *mm.*; of the same character below, but less numerous; a bare strip running along edges of genital slits. Arm-spines five, robust, rounded, somewhat flattened, a little tapering, blunt; the longer ones sometimes bent; third spine from the top longest; the longest spines are near the twentieth joint; lengths to that of under arm-plate (eighteenth joint), 2, 2.2, 2.7, 1.8, 1.5 : 1.2; two lowest spines more slender than the upper ones. Sometimes a short supplementary spine above. Longest spine on this specimen, 3.2$^{mm.}$. There are five spines to each joint till close to the tip of the arm, where there are only four. Close to the disk there are commonly six spines, which, however, are a good deal smaller and more even than those beyond. Tentacle-scales large, rounded oval, length to that of under arm-plate, .5 : 1.2; on first two or three joints two, on all the rest only one. Color, in alcohol: above, disk uniform gray-brown (Cologne earth and neutral tint); arm-spines and upper arm-plates light yellowish-brown; the former darker at their base;

arms cross-barred with darker bands, from two to four joints on each band; some of the upper arm-plates finely marbled with lighter; below, mouth parts and interbrachial spaces having several shades of brownish yellow; under surface of arms light-brown, a longitudinal brown line runs along the lateral sides of the under arm-plates.

Variations. — The pattern of the color varies little, but the ground tints may have more of yellowish, gray, or brown; it very rarely happens that the arms are not banded. The proportions of arms to disk give such differences as the following: 12 : 65, 15 : 100, 16 : 135, 17.5 : 112. The largest specimen I have seen had a disk of 22$^{mm.}$. Very large specimens have seven spines on some of the joints, and six on most; where there are six spines, it is the fourth that is longest. A young one, with a disk of 3.2$^{mm.}$, had arms of about 22$^{mm.}$; the disk was covered with imbricated scales, with a few large grains; the upper and under arm-plates were similar to those of the adult, but longer; the arm-spines were four, rounded, tapering, and much stouter than those of the adult; the number of mouth-papillæ was the same as in older ones, but there were only two tooth-papillæ. I have seen no young ones with six arms.

O. Alexandri was first received from my friend, Mr. Alex. Agassiz, after whom I have named it. It resembles *O. pumila*, but differs in having the third or fourth arm-spine much longer than the rest.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
300	. .	2	Acapulco, Mexico.	. . . . .	Alex. Agassiz.	Alcoholic.
301	1171	5	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"
			Smithsonian Institution.			
1171	. .	12+	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.
1189	. .	12+	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"

Ophiocoma Riisei Lütken.

Ophiocoma Riisei Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiocoma Riisei Lütken. Addit. ad Hist. Oph., p. 143.

Special Marks. — Arm-spines slender and even; upper one considerably the longest. Mouth-shields ovoid in outline, with the narrow end inward.

Description of a Specimen. — Diameter of disk, 13.4$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 6$^{mm.}$; greatest breadth of arm without spines, 3$^{mm.}$; length of arm, 63$^{mm.}$; distance from outer edge of mouth-shield to inner point of tooth-papillæ, to that between outer corners of mouth-slits, 2.6 : 2.8; on each side four mouth-papillæ, of which that next the outer one is about twice as broad as the others, which are more pointed and rounded; four irregular horizontal rows of rounded, crowded tooth-papillæ, three in each row, the lowest row on a level with the mouth-papillæ, and consisting of three (sometimes four) papillæ, of which the middle one is the smallest, and all smaller and more flattened than those of the upper rows; four flat, square teeth, projecting beyond the tooth-papillæ. Mouth-shields with an outline nearly like that of an egg, the small end pointing inward; length to greatest breadth, 1.8 : 1.4; the outer end is not evenly rounded, but makes a little projection to form part of the bridge between the inner ends of the genital slits; at their widest part the shields seldom fill the width of the interbrachial spaces. Side mouth-shields triangular, soldered for their whole length to the sides of the mouth-shields, their inner end about on a line with that of the mouth-shield; length to breadth, 1.2 : .8. Basal under arm-plates, and those in middle part of arm, somewhat square, but having six sides, viz.: an outer side, long and curved; an inner, a little re-enteringly curved; two laterals, long, and re-enteringly curved to admit tentacle-scales; and two inner laterals, of about the same length as the inner side. Farther out on arm these sides are less sharply distinguished, the inner laterals becoming merged in the curve of the inner side; and at the tip of arm the plates are elongated, and there are but four sides, an outer and inner, which are curved, and two laterals, which are re-enteringly curved. Length to breadth of plates: second, .6 : .8; third, 1 : 1.2; seventh, 1.2 : 1.6; about two thirds the length of arm, .8 : .8; close to the tip of arm, .6 : .4. Side arm-plates encroach at base of arm, on upper and lower plates, but do not meet above till near the end of arm, and do not meet below except at the very tip. Upper arm-plates pointed oval, but varying in shape; many, though somewhat oval, are angular; first plate rudimen-

tary; for more than half the length of arm, the proportions do not alter much, though the plates grow smaller, but there are such variations among individual plates as 1.2 : 1.6, 1.2 : 2; farther out, plates ill defined, very wide and short; length to breadth, .8 : 1.4; still farther out, plates well defined again, heart-shaped, the point inward; length to breadth, .6 : .8. Disk, above, evenly and rather closely granulated with bead-like grains, about sixteen, on the average, to a square *mm.*; underneath, no granulation, except on a small triangular space which is continued from the upper surface; the rest of the interbrachial space covered with fine, obscurely marked scales, about .3$^{mm.}$ long. Arm-spines on second joint two, their lengths to that of the under arm-plate, 1.6, 1.6 : 1; third joint, three spines, 1.4, 1.8, 1.8 : 1.2; fifth joint, four spines, 1.8, 1.8, 2, 2.2 : 1.2; eleventh joint, four spines, 4.8, 4.4, 4.4, 4.4 : 1.2; about two thirds the length of the arm, 3.4, 2.8, 2.2, 2.2 : .8; close to tip of arm, three spines, .8, .6, .6 : .6. From near the disk to about two thirds the length of the arm, there are sometimes four, sometimes three spines to each joint, these numbers often alternating; on the joints not enclosed by the disk, the upper spine is generally much the longest, and is more rounded, particularly on those joints that have as many as four spines, while the remaining two or three are nearly equal. The characteristic upper spine is slender, pretty even, nearly cylindrical, with a thickness to length as .8 : 4.8. Tentacle-scales, two on first pair of pores, and rarely on second pair; on all the rest, only one; in shape regular oval; length of those on third joint, to length of under arm-plate, .6 : 1.2. Color, in alcohol: roof of disk brown (Cologne earth), with obscure radiating bands of darker; interbrachial spaces lighter; under arm-plates uniform light-brown; chewing apparatus and mouth-shields still lighter; upper arm-plates brown, with occasionally some much darker, thus making cross stripes. Uppermost arm-spines mottled with lighter and darker brown; lower spines like under arm-plates; tentacle-scales like under arm-plates.

Variations. — This species is common in the West Indies, though not so much so as *O. echinata*, which lives side by side with it. The disk often attains a size of 24$^{mm.}$, with arms five or six times as long, and the longest upper arm-spines 10$^{mm.}$. The color in full-grown specimens is singularly invariable; the arm-spines may be more or less inclined to reddish or to umber brown. Small specimens often have the back of the disk ornamented with a star, of dark brown, made up of two radiating lines in each brachial space. The granulation of the interbrachial spaces below may be more or less perfect.

O. Riisei may be distinguished from *O. echinata* by the different shapes of mouth-shields and upper arm-spines; and from *O. æthiops* by much narrower upper arm-plates.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
276	. .	12+	Florida.	. . . . .	Prof. Agassiz.	Alcoholic.
277	. .	1	Bay of Cumana.	. . . . .	Capt. Couthouy.	"
278	. .	3	Key West, Fla.	Feb. 1856.	T. Lyman.	"
279	. .	4	Tortugas, Fla.	Mar. 13, '58.	J. E. Mills.	"
280	. .	4	Key West, Fla.	Mar. 6, 1858.	J. E. Mills.	"
281	. .	1	Tortugas, Fla.	Ap. 14, 1858.	J. E. Mills.	"
282	. .	1	Cape Florida.	Apr. 1858.	J. E. Mills and G. Wurdeman.	"
283	. .	2	Florida.	. . . . .	Prof. Agassiz.	"
284	. .	3	Cape Florida.	. . . . .	G. Wurdeman.	"
285	. .	9	Jeremie, Hayti.	1858.	Dr. D. F. Weinland.	"
286	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
287	. .	12	Tortugas, Fla.	Mh.13-19,'58.	J. E. Mills.	"
288	61	1	West Indies.	. . . . .	University Museum, Copenhagen.	"
289	. .	12+	Florida.	. . . . .	G. Wurdeman.	Dried.
290	. .	12+	Florida ?	. . . . .	. . . . .	"
365	. .	. .	Key West, Fla.	. . . . .	Dr. Holder.	Alcoholic.
			Smithsonian Institution.			
1100	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
998	. .	12+	Florida Keys.	. . . . .	. . . . .	"
1000	. .	7	Tortugas, Fla.	Mh. 18, '58.	. . . . .	"
1176	. .	3	Tortugas, Fla.	. . . . .	Dr. Whitehurst.	"
1089	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiocoma æthiops Lütken.

Ophiocoma æthiops Lütken. Addit. ad Hist. Oph., p. 145.

Special Marks. — Large species. Greatest width of arms more than three times as great as the length of the under arm-plates. Upper arm-spine thickened.

Description of a Specimen. — Diameter of disk, 31$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 13$^{mm.}$; greatest width of arm without spines, 7$^{mm.}$; length of arm, 190$^{mm.}$; distance from outer edge of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 5.6 : 6.3. Eight broad, rounded mouth-papillæ to each angle of mouth; of these the one next the outer one usually broadest; besides these, a row of three or four minute bead-like mouth-papillæ, just below and outside of the tooth-papillæ, with which they might properly be classed. Tooth-papillæ about eighteen, irregularly disposed, short, stout, rounded, the two or three lowest bead-like and much smaller than the rest. Teeth four, shaped

like flattened, rounded wedges, somewhat narrower within than without. Mouth-shields oblong, with rounded corners; length to breadth, 4 : 3. Side mouth-shields small, rather variable in size, triangular; length to breadth, 1.5 : 1. Under arm-plates squarish; third, fourth, fifth, and sixth plates of nearly equal size, and smaller than those beyond, their lateral sides nearly straight, their outer and inner sides a little curved, length to breadth, 2 : 2; seventeenth plate typical in shape, outer side slightly curved, lateral sides straight, and sloping a little inward and towards each other, inner side making rather a strong curve; length to breadth, 2.3 : 2.3; about two thirds out on arm, plates almost square, with straight sides, and corners a little rounded, length to breadth, 1.7 : 1.7; close to tip of arm, plates twice as long as broad, elongated oval, broader without than within. Side arm-plates encroaching on upper and lower arm-plates, sometimes nearly meeting below, and thus slightly separating two neighboring plates; they do not properly meet above and below till close to tip of arm. Upper arm-plates much broader than long, shaped like a narrow oval, with pointed corners; near base of arm, length to breadth, in broader ones, 2.2 : 6.5; in narrower ones, 2.2 : 5. First plate rudimentary, very short and narrow, partly covered by granulation of disk; second, third, and fourth plates rather narrower than those just beyond, and often stouter, so that the arm looks constricted at its base. The plates maintain the same general shape and proportions till close to tip of arm. Granulation of disk close, fine, and bead-like, both above and below; near base of arms above, coarser and more scattered; about 30 grains to a square *mm.* where granulation is thickest; below, granulation reaches nearly, or quite, to edges of genital slits. Arm-spines stout, rounded, somewhat flattened, the lowest ones most so, increasing in thickness from below above; near base of arm, usually four. Second, third, and fourth joints each with three small, very flat spines, lowest one usually longest, sometimes $2^{mm.}$; on next three or four joints, spines grow more rounded and tapering, in number three, four, or rarely five; on seventeenth joint, typical spines, lengths to that of under arm-plate, 5, 4.5, 4, 4 : 2.3; beyond this, joints with three and with four spines usually alternate till a point about three fourths the length of the arm, after which there are only three slender, rounded, tapering spines, of nearly equal length and thickness. Tentacle-scales nearly regular oval, a little pointed without, rather thick, length to that of under arm-plate, 1 : 2.3; only one on each pore, except pores of second joint, and a few others scattered, which have two. Color, in alcohol: above, dark, rich vandyke-brown, disk irregularly and obscurely radiated with darker and lighter; below, interbrachial spaces uniform brown; rest same color, but considerably lighter.

Variations. — In other specimens the disk was to the arms as 29 : 145, 32 : 162, 10.5 : 56. Tentacle-scales vary much in number on specimens of same size, and even on same individual; occasionally there are regularly two scales to each pore as far out as the thirty-third joint, but this is unusual. Tooth-papillæ commonly arranged in five regular horizontal rows, of three each. Granulation of disk does not always cover whole of interbrachial spaces below, but a broad band may be left running along the genital slits, and outside the mouth-shield. Color varies to a certain extent. It may be even dirty white, blotched with dark brown, on the upper side of the disk, with lower side of arms very light brown, the lower arm-plates being more or less mottled; extremities of arms may be banded with darker and lighter. A young one having a disk of $10.5^{mm.}$ was similar to the larger specimens, but had the arms banded for their whole length, the arm-plates speckled with lighter, the mouth-papillæ regular and bead-like, and the tooth-papillæ in horizontal rows of only two each.

This species is distinguished from *O. echinata* and *O. Riisei* by wider and flatter arms, and by differently shaped arm-spines and mouth-shields.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
302	. .	12+	Acapulco, Mexico.	. . . . .	Alex. Agassiz.	Alcoholic.
303	. .	12+	Panama.	. . . . .	Alex. Agassiz.	"
304	. .	7	Panama.	. . . . .	Alex. Agassiz.	"
305	1170 & 1190	3	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"
			Smithsonian Institution.			
1007	. .	4	Panama.	. . . . .	Dr. Sternbergh.	Alcoholic.
1008	. .	4	Panama.	. . . . .	Rev. T. Powell.	"
1011	. .	1	Panama.	. . . . .	Dr. Suckley.	"
1185	. .	4	West Coast Nicaragua.	. . . . .	Capt. Dow.	Dried.
1170	. .	12+	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.
1190	. .	5	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	"

Ophiocoma nigra Müll. & Trosch.

Asterias nigra O. F. Müll. Zoöl. Dan., Pl. XCIII.
Ophiocoma granulata Forbes (*non* Linck.). Brit. Starfishes, p. 50.
Ophiocoma nigra Müll. & Trosch. System der Asteriden, p. 100.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
308	. .	3	Greenland.	. . . . .	Prof. Sars, 1852.	Alcoholic.
309	. .	1	Norway.	. . . . .	University Museum, Copenhagen.	"

Ophiocoma echinata Agass. (Fig. 5.)

Ophiura echinata Lamk. Hist. An. sans Vertèb., II. p. 540. 1816.
Ophiocoma echinata Agass. Prodrome. Mém. Soc. Scien. Nat. de Neuchatel, I. 1835.
Ophiura crassispina Say. Journ. Phil. Acad., V. p. 147. 1825.
Ophiocoma crassispina Müll. & Trosch. Syst. Asterid., p. 103.
Ophiocoma serpentaria Müll. & Trosch. Syst. Asterid., p. 98.
Ophiocoma crassispina Lütken. Addit. ad Hist. Oph., p. 142.

Special Marks. — Upper arm-spine much thickened; mouth-shields nearly square, with rounded corners.

Description of a Specimen. — Diameter of disk, 23.6$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 9.4$^{mm.}$; greatest width of arm without spines, 4$^{mm.}$; length of arm, 100$^{mm.}$; distance from outer edge of mouth-shield to points of tooth-papillæ, to that between outer corners of the mouth-slits as 2 : 2.6. On each side of the mouth-frames four mouth-papillæ, of which the three outer ones have their grinding edge bevelled, which makes the outer edge shorter than the inner one; the innermost papilla points towards the centre of the mouth, and is stout and more conical than the others; the other three are also stout, but are more flattened; their corners and edges are rounded. On the jaw, four irregular, horizontal rows of stout, rounded, close-set tooth-papillæ, three in each row; the lowest row is on a level with the line of the mouth-papillæ, and the tooth-papillæ of this row are smaller than the rest, and moreover may vary in number, being some-

Fig. 5.
Ophiocoma echinata. Chewing apparatus, seen from within. d', tooth-papillæ; d'', teeth.

times only two, or again four; and in addition there is sometimes another very small papilla below and outside this row. Teeth four, their inner ends nearly square, upper one more tapering and rounded. Mouth-shields a little longer than broad, squarish, with rounded corners; length to breadth, 2.6 : 2. Side mouth-shields small, like elongated triangles, lying close to, and soldered with, the sides of the mouth-shields, their inner ends nearly on a line with those of the mouth-shields. The general shape of the under arm-plates at the base of the arm, and so outwards nearly to the tip, is square; lengths to breadths as follows: second plate, 1.4 : 1.4; sixth plate, 1.4 : 1.8; about two thirds the length of the arm, 1.2 : 1.6; plates on the tip joint, .8 : .6. The plates have really six sides, of which the inner and outer ones are parallel to each other, and are straight; the inner lateral sides are slightly re-entering curves, the outer lateral sides are straight and short. In the sixth plate the proportions of the sides are as follows: inner, 1.6; outer, 1; inner lateral, 1; outer lateral, .6. The rest of the plates for some distance along the arm do not materially differ from the sixth plate in their proportions. The first under arm-plate bounds the outer corner of the mouth-slit, and is very small; it is somewhat heart-shaped, the length to breadth as 1 : .8. Side arm-plates thick and stout, covered up by a thick skin, except a triangular piece, which fills the space between the base of the upper arm-spine, and the angle formed by the corners of the nearest pair of upper arm-plates. Towards the tip of the arm the side plates are better seen, having a thinner skin over them; also, as is usual, they encroach more and more on the upper and lower plates; at the tip of the arm they meet above and below. Upper arm-plates vary somewhat in size and in their outlines; the general form is oval, with pointed ends; each overlaps a little the next outer one, less, however, at the tip of the arm, than nearer its base; the innermost plate is rudimentary; length of the sixth plate to breadth as 1.6 : 3; close to the tip of the arm the plates are heart-shaped, with the point turned inward, the length being to the breadth as .6 : .8; for at least three fourths the length of the arm, though the plates gradually grow smaller, the average proportions of length to breadth among them remain about the same, but single plates vary so as to give such differences as 1.6 : 2.6, 1.6 : 3.8; the variable diameter is the breadth. Disk, above, evenly and rather closely granulated, with smooth, bead-like grains, about 25, on the average, to a square *mm.*; below, the interbrachial spaces have a band on each side, running parallel to the genital slits, which is without grains, and shows the under coat of small, thin, overlapping scales, the largest of them about .1$^{mm.}$ long; in the midst of the interbrachial spaces the granulation is as above, except near the mouth-shields, where the grains are few and scattered. The genital slits have, near the mouth-shields, a raised granulated ridge

running along their edge; their inner ends are separated by a bridge of about one half the width of the mouth-shields. Arm-spines of moderate length, and two upper ones quite stout. Second joint three spines, small and flattened, with rounded ends; lengths to that of lower arm-plate: upper, .8 : 1.8; lowest, 1.8 : 1.8; middle, 1.2 : 1.8; third and fourth joints have three spines; the fifth, and those immediately beyond, four. Five spines on each side are rare; at about one fourth the length of the arm there again begin to appear only three spines, and joints bearing this number often alternate with those having four; still farther out, as many as four spines become rare, and near the tip of the arm there are only three. Fifteenth joint four spines, lengths to that of under arm-plate, 3.6, 3.2, 2.4, 2.4 : 1.6; the upper spine is much the largest; it is rounded, slightly curved, flattened, and tapering, and is very stout; its greatest thickness to its length as 1.2 : 3.6; the next lower is of about the same proportions, but somewhat less stout; the two lowest are more tapering, and much more flattened. These four may be considered the characteristic spines of the species; the upper spine is the most variable, and may have a proportionate length as great as 4.2; as they approach the end of the arm, the spines become proportionately longer, more slender, and less flattened; lengths to that of under arm-plate, 3, 1.6, 1.8 : 1.2; the two lower ones are still much flattened, but the upper one is nearly cylindrical, and varies in length from 2.4 to 3.6; at the tip of the arm the upper spine has quite lost its stout, blunt character, and has become very slender; the lengths of spines to that of under arm-plate, 1.4, 1.2, 1.2 : .8. There are two tentacle-scales to each pore, and this number continues for about three fourths the length of the arm, when pores with only one scale begin to appear; sometimes there will be several such, followed by several more, each with two scales, but the last joints have but one scale to each pore; near the disk their length is to their breadth as 1 : .4, they are much flattened, widest near the top, somewhat contracted at the base; the inner is usually a trifle the longer; they stand close, side by side. Color, in alcohol: roof of the disk light brown, mixed with some light-brownish gray, and ten indistinct radiating lines of the latter color; below, interbrachial spaces similarly colored, but the edges of the genital slits are nearly white; the ground color of the mouth-papillæ, side mouth-shields, and mouth-shields, is nearly white, but they are more or less clouded with light brown; the under arm-plates, for one fourth or one third the length of the arm, are whitish, with a large spot of brown; farther out the plates are entirely brown. The side arm-plates are yellowish, finely mottled with light brown. The upper arm-plates are purplish brown, with one, two, or three plates at varying distances, much lighter colored, thus giving an irregular barred appearance. The upper and second arm-spines are light purplish-brown, their points and

sides marked with lighter; near the tip of the arm they are somewhat lighter colored; third and fourth arm-spines pure white below, above white, with a broad central line of purplish brown; tentacle-scales white, with small purplish-brown spots, of which one is almost always at the base of the scale.

Variations. — The color, though varying in intensity, is usually as described above; sometimes, however, the upper surface of the disk bears large patches of light grayish; and, again, the whole animal may be light gray, variously marked and clouded with brown; this pattern is seldom seen, except in the young. The granulation of the interbrachial spaces below differs; sometimes it completely covers the whole area; at other times, particularly among the young, it is confined to a small triangular patch in the centre. A young one, with a disk of $9^{mm.}$, had arms $47^{mm.}$ long; the under arm-plates were a good deal broader without than within, the outer side being strongly curved, and the laterals re-enteringly curved; the disk granulation was only partial below, but perfect above, with about 90 grains to a square *mm.*; there were only three rows of tooth-papillæ.

O. echinata is the commonest of the West Indian Ophiuridæ. It has been found from low-water-mark to four fathoms; usually on corals, but often, also, on *Gorgonia flabellum*. The color does not change in alcohol. The species is distinguished from *O. Riisei* by the shape of the upper arm-spine and of the mouth-shields, and from *O. æthiops* by much narrower upper arm-plates.

Müller & Troschel state that Lamarck confounded several species under the name of *echinata*, and among them a specimen from the Antilles, brought by Plée, and which they make the type of their *O. serpentaria*. They exclude *O. echinata* entirely, without any reason at all. The real original of Lamarck is a dried specimen in the Jardin des Plantes, which, as I satisfied myself, was brought by Maugé from Porto Rico in 1799. This is no other than the *Ophiura crassispina* afterwards described by Say, and identical also with Plée's specimen above mentioned.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
256	. .	9	Bay of Cumana.	. . . . .	Capt. Couthouy.	Alcoholic.
257	. .	8	Florida.	. . . . .	Prof. Agassiz.	"
258	. .	7	Cape Florida.	Apr. 1858.	J. E. Mills and G. Wurdeman.	"
259	. .	4	Florida ?	. . . . .	Prof. Agassiz.	"
260	. .	12+	Tortugas, Fla.	Mch. 1858.	J. E. Mills.	"
261	. .	3	Tortugas, Fla.	Feb. 1856.	T. Lyman.	"
262	. .	6	Tortugas, Fla.	Ap. 24, 1858.	J. E. Mills.	"
263	. .	3	Hayti.	. . . . .	E. Habich.	"
264	. .	5	Tortugas, Fla.	Mh. 15, 1858.	J. E. Mills.	"
265	. .	1	Hayti.	1858.	Dr. D. F. Weinland.	"
266	. .	1	Key West, Fla.	Mh. 6, 1856.	J. E. Mills.	"
267	. .	12+	Jeremie, Hayti.	1858.	Dr. D. F. Weinland.	"
268	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
269	. .	5	Florida.	. . . . .	G. Wurdeman.	"
270	. .	2	Florida.	. . . . .	Prof. Agassiz.	"
271	63[a]	4	West Indies.	. . . . .	University Museum, Copenhagen.	"
272	63[b]	2	West Indies.	. . . . .	" "	"
273	141,142	12+	Tortugas, Fla.	Mh. 4-19, '58.	J. E. Mills.	"
274	. .	12+	Florida.	. . . . .	G. Wurdeman.	Dried.
275	. .	12+	Florida ?	. . . . .	. . . . .	"
358	. .	. .	Florida.	. . . . .	S. H. Scudder.	Alcoholic.
			Smithsonian Institution.			
996	. .	12+	Tortugas, Fla.	. . . . .	. . . . .	Alcoholic.
997	. .	12+	Florida Keys.	. . . . .	. . . . .	"
987	. .	6	Tortugas, Fla.	. . . . .	Dr. Whitehurst.	"
990	. .	4	Cape Florida.	May, 1858.	G. Wurdeman.	"
999	. .	12+	Tortugas, Fla.	Mh. 18, 1858.	. . . . .	"
984	. .	6	Tortugas, Fla.	. . . . .	Capt. Woodbury.	"
985	. .	1	Cape Florida.	. . . . .	G. Wurdeman.	"
1018	. .	1	West Indies.	. . . . .	University Museum, Copenhagen.	"
1004	. .	2	Aspinwall.	. . . . .	Rev. T. Powell.	"
1101	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1077	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiocoma erinaceus Müll. & Trosch.

Ophiocoma erinaceus Müll. & Trosch. Syst. Asteriden, p. 98.
Ophiocoma tartarea Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 78.
Ophiocoma erinaceus Lütken. Addit. ad Hist. Oph., p. 164.

Special Marks. — Black or dark brown; arms from three and a half to five and a half times as long as diameter of disk; two tentacle-scales; interbrachial spaces below not granulated.

Description of a Specimen. — Diameter of disk, $25^{mm.}$; breadth of arm without spines, $4^{mm.}$; length of arm, $132^{mm.}$; tooth-papillæ fourteen to eighteen, sometimes in transverse rows of three, sometimes irregularly

placed. Teeth stout, thickened, four in number. Mouth-shields longer than broad, broader without than within, corners all rounded; outer side curved, or made up of three lines; lateral sides re-enteringly curved; length to breadth, 3.3 : 2.8. Side mouth-shields triangular, small, broad, lying entirely on the sides of the mouth-shields. Under arm-plates considerably broader than long; a little way from the disk, regularly hexagonal; length to breadth (fourteenth plate), 1.9 : 2.5. Upper arm-plates broader than long, somewhat affected in shape by the number of arm-spines; most are either hexagonal or oval hexagonal, with very sharp lateral corners; length to breadth (thirteenth plate), 1.9 : 4.2. Disk very regularly and finely granulated above, about 14 to a square *mm.*; below, interbrachial spaces naked, showing the fine scales. Arm-spines, near base of arm, alternating five and four, rarely six; farther out, four and three; at the tip of the arm only three; upper spine very long, slender, cylindrical, slightly tapering, sometimes a little curved; other spines smaller; within the disk the lowest spine is often much flattened and widened at its end; lengths to that of under arm-plate, 9, 6.8, 5.5, 5.5, 3.5, 3.5 : 1.9. Tentacle-scales two, nearly to the tip of the arm; outside one oval, inside one more or less irregular. Color, in alcohol, black, the under surface of the arms having a brownish shade.

Variations. — This species presents, with a wide geographical range, a considerable variation in the length of the arms, and in the length and stoutness of the arm-spines. As a rule (not, however, absolute), specimens from the Pacific Islands have longer and more slender arms and arm-spines. It is this variety that I described as *O. tartarea.* The original description of Müller is insufficient.

The specimen above described had spines of the maximum length. Another large specimen, with a disk of $27^{mm.}$ and arms of $150^{mm.}$, had the spines as follows: 6, 5.5, 4, 3.3, 2.7. The spines of another were 5.8, 4.5, 3.5, 2.8, 2.5, the disk being $22^{mm.}$. A partly grown specimen from Kingsmills Islands belonged apparently to this species; the disk was $20^{mm.}$ in diameter, and the spines were 5, 3, 2.6, 2.6, 2.6. A specimen in the Jardin des Plantes, from the Iles Seychelles, had a disk of $31^{mm.}$, and the arm $98^{mm.}$; the spines being 6, 3.8, 3.8, 3.2. The upper spine was swollen, as in *O. echinata;* the three lower ones flattened, and cut short off at the end. The color was nearly black. I have seen a large specimen from Zanzibar, whose disk had a diameter of $30^{mm.}$, while the longest arm-spine was only $4.6^{mm.}$. There were only four spines, except, perhaps, at the very base of the arm.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
307	. .	6	Zanzibar.	. . . . .	Mr. Cheney.	Alcoholic.
312	. .	3	Sandwich Islands.	. . . . .	A. Garrett.	"
313	. .	4	Sandwich Islands.	. . . . .	A. Garrett.	"
314	26 & 28	2	Sandwich Islands.	. . . . .	A. Garrett.	Dried.
315	. .	9	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.
316	. .	3	Kingsmills Islands.	. . . . .	A. Garrett.	Dried.
366	. .	. .	Zanzibar.	. . . . .	E. Ropes.	Alcoholic.
368	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"
369	. .	. .	Zanzibar ?	. . . . .	Salem Normal School.	"
370	. .	. .	Mozambique.	. . . . .	C. Cooke.	"
367	. .	. .	Society Islands.	. . . . .	A. Garrett.	"
431	. .	. .	Iles Seychelles.	. . . . .	Jardin des Plantes.	"

Ophiocoma scolopendrina Agass.

Ophiura scolopendrina Lamk. Hist. An. sans Vertèb., II. p. 544.
Ophiocoma scolopendrina Agass. Prodrome. Mém. Soc. Scien. Nat. Neuchatel, I. 1835.
Ophiocoma scolopendrina Lütken. Additamenta ad Hist. Oph., p. 163.
Ophiocoma molaris Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 79.

Special Marks. — Arms five and a half to eight times the diameter of the disk. Spines ringed with darker and lighter; upper one longest. Granulation of disk even, and rather fine. Color, grayish or mottled.

Description of a Specimen. — Diameter of disk, 24$^{mm.}$; width of arm without spines, 4$^{mm.}$; length of arm, 137$^{mm.}$. Mouth-papillæ eleven or twelve, the innermost two much the smallest. Tooth-papillæ seven or eight, rather large. Teeth four, upper one narrowest and sharpest. Mouth-shields longer than broad, much narrower within than without, pretty regular; bounded without by a curve, within and on the sides by straight lines; length to breadth, 2.6 : 2. Side mouth-shields small, triangular, lying on the sides of the mouth-shields. Under arm-plates rather broader than long, hexagonal, the outer side and outer laterals being more conspicuous than the corresponding sides within; length to breadth (tenth plate), 1.5 : 2. Upper arm-plates broader than long, quite irregular, varying in breadth according to the encroachment of the upper arm-spines; oval, with pointed lateral corners; length to breadth (seventh plate), 1.5 : 3.4. Disk regularly, but rather loosely granulated, 20 to a square *mm.*; below, interbrachial spaces granulated, except a band along each genital slit. Arm-spines near base of arm, alternating four and three, slender, elegant, little tapering, somewhat

flattened; upper one longest and largest, but never *swelled;* lengths to that of under arm-plate, 5.5, 3.5, 2.5, 2 : 1.5. Tentacle-scales two on base of arm, but a little way out only one. Color, in alcohol: above, umber brown; below, interbrachial spaces the same, the other parts lighter; some of the arm-spines ringed with lighter.

Variations. — The same variations, as to the length of the arms, and the length and stoutness of the arm-spines, exist in this wide-ranging species, as in *O. erinaceus;* and the parallel is further carried out by the fact that the specimens from the east coast of Africa have commonly, though not always, shorter arms and stouter spines than those from the Pacific Islands. The latter variety I have described as *O. molaris.*

The arms vary from five and a half to eight times the diameter of the disk. The tooth-papillæ are commonly about nine, rarely twelve. The color varies in depth; the lightest specimens are pale bluish-gray, varied with specks and marblings of white; below, nearly white, with brown lines round the under arm-plates. The lighter the color, the more conspicuous are the dark rings round the spines. The number of joints furnished with two tentacle-scales varies somewhat, often differing on the different arms of the same individual. A specimen with a disk of 23$^{mm.}$ had arms of 161$^{mm.}$; length of arm-spines to under arm-plate, 4.5, 4, 3, 2.5 : 1.4. A small specimen had the disk 14$^{mm.}$, arms 110; arm-spines to under arm-plate, 4, 2.5, 2, 1.6 : 1.1. The original *Ophiura scolopendrina* of Lamarck is a dried specimen, from the Ile de France, and now in the Jardin des Plantes. The disk is 27$^{mm.}$ in diameter; arm, 175$^{mm.}$ long; upper arm-spine, 3.5$^{mm.}$ long, somewhat swelled, ringed with white and brown. The disk yellowish brown; arms mottled, light grayish-brown and dirty white. Arm-spines three or four, the three lowest much more slender, and somewhat shorter, than the upper.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
324	. .	12+	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.
325	. .	3	Kingsmills Islands.	. . . . .	A. Garrett.	Dried.
432	. .	. .	New Guinea.	. . . . .	Jardin des Plantes.	Alcoholic.
360	. .	. .	Zanzibar.	. . . . .	Capt. Ashby.	"
361	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"
362	. .	. .	. . . . .	. . . . .	. . . . .	"
363	. .	. .	Mozambique.	. . . . .	C. Cooke.	"
364	. .	. .	Arabian Gulf.	. . . . .	Capt. Millet.	"

Ophiocoma insularia Lyman.

Ophiocoma insularia Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 80.

Special Marks. — Lower spines longer than the upper; arms flat, about four times as long as diameter of disk; under arm-plates regular, and about as long as broad; interbrachial spaces below closely granulated.

Description of a Specimen. — Diameter of disk, 30$^{mm.}$; width of arm without spines, 4.5$^{mm.}$; length of arm, 125$^{mm.}$. Mouth-papillæ, six on each side; under the teeth there cannot be said to be any mouth-papillæ, because the tooth-papillæ, which sometimes are as many as twenty, extend downwards and outwards, growing smaller and smaller, till they nearly reach the inner end of the mouth-shield. Teeth four, flat and squarish, upper one smallest. Mouth-shields about as long as broad, much rounded, without straight lines; length to breadth, 2.8 : 2.5. Side mouth-shields small, triangular, lying entirely on the sides of the mouth-shields. Under arm-plates about as broad as long, bounded without by a curve, and within by a short inner side and two inner laterals; length to breadth (sixteenth plate), 2 : 2. Upper arm-plates even and regular, much broader than long, bounded without by a clean curve, and within by an inner side and two inner laterals; length to breadth, 2 : 4. Granulation of the disk extremely close and fine above and below, and extending even to the outer corner of the side mouth-shields; about 45 to a square *mm.* Arm-spines rather short, little tapering, blunt, a good deal compressed; on the first few joints beyond the disk, four, very rarely indeed five; farther out, three; they do not alternate three and four, as is seen in many other species; lengths to that of under arm-plate, 3, 3.1, 3.6, 3.5 : 2. Tentacle-scales two, large and regular, much longer than broad. Color, in alcohol: above, deep umber, almost black; below, interbrachial spaces the same; arms a little lighter.

Variations. — A young specimen, with a disk of 9.5$^{mm.}$, had arms 35$^{mm.}$ long; the mouth-shields were narrower than in the adult, the color was paler, and the tips of the arms were cross-barred with white. A very large specimen, with a disk 33$^{mm.}$ in diameter, had arms 155$^{mm.}$ long; the proportion of the arm-spines to the under arm-plate was 3.5, 3.5, 3.7, 3.7 : 2; the upper spines were greatly flattened, and were cut square off at the end. Some well-grown individuals have cross-bars of light-brown towards the end of the arm.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
317	. .	3	Sandwich Islands.	. . . . .	A. Garrett.	Alcoholic.
318	. .	7	Sandwich Islands.	. . . . .	A. Garrett.	"
319	. .	12+	Sandwich Islands.	. . . . .	A. Garrett.	"
320	. .	1	Sandwich Islands.	. . . . .	A. Garrett.	Dried.

Ophiocoma pica Müll. & Trosch.

Ophiocoma pica Müll. & Trosch. Syst. Asteriden, p. 101.
Ophiocoma lineolata Müll. & Trosch. Syst. Asteriden, p. 102.
Ophiocoma sannio Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 81.

Special Marks. — Arms to disk as four to one; they are banded with yellowish. Six arm-spines in the adult, slender and elegant; upper ones longest, and as long as the combined lengths of three and a half to four and a half under arm-plates.

Description of a Specimen. — Diameter of disk, 27$^{mm.}$; width of arm without spines, 4$^{mm.}$; length of arm about 90$^{mm.}$. Mouth-papillæ six; three on each side. Tooth-papillæ irregularly placed, extending nearly to the inner end of the mouth-shield, the lowest ones smallest; about twenty-one in number. Teeth five, lowest one very small, and nearly surrounded by papillæ; upper one small, and somewhat pointed. Mouth-shields oval, longer than broad; length to breadth, 2.5 : 2. Under arm-plates broader than long, regular, bounded without and within by a curve, on the sides by re-entering curves; length to breadth (tenth plate), 1.4 : 2. Upper arm-plates very regular, bounded without by a clean curve, nearly oval, but flattened a little within; length to breadth (tenth plate), 1.4 : 2.4. Disk, above and on the sides, finely and closely granulated, about 45 grains to a square *mm.*, brachial spaces below naked; showing unusually large scales, having a diameter of .5$^{mm.}$. Arm-spines six, remarkably slender, tapering, and regular; lengths to that of under arm-plate, 5.2, 6, 5, 4.2, 3.8, 3.2 : 1.4. Tentacle-scales two, rather large and pointed. Color, in alcohol: above, very dark purplish-brown; the disk ornamented with numerous fine radiating lines of yellowish; two yellowish specks at the base of each arm; about every other upper arm-plate is cross-barred with yellowish, the base of the upper spine having the same color; below, interbrachial

spaces dark brown, varied with yellowish; yellowish spots between the under arm-plates.

Variations. — The arrangement of colors on the disk varies; sometimes the disk is wholly dark, or, again, only spotted with light yellowish; but the arms are always more or less banded with light. A light mark on each side of the mouth-shield is very characteristic. A young specimen, with a disk of $9^{mm.}$, had arms $34^{mm.}$ long; there were five arm-spines. Another had four, and close to the disk five arm-spines; the disk was to the arms as 6 : 21. In younger specimens the tooth-papillæ are of course fewer.

Müller & Troschel made the singular mistake of describing this strongly marked species under two names, *O. pica* and *O. lineolata*. Both descriptions are inaccurate; so much so that I described it under a *third* name, *O. sannio*. A glance at the originals in the Jardin des Plantes and the Berlin Museum, was enough to remove all error. The originals of *O. pica*, in Paris, are dried, and about half grown. Disk, $15^{mm.}$; arm, $50^{mm.}$; five arm-spines, of which the upper is $3.2^{mm.}$ long. The original of *O. lineolata* (Berlin Zoöl. Mus., No. 951) is also not quite fully grown. The disk is $18^{mm.}$ in diameter; arm, $58^{mm.}$ long; five rows of spines, whereof the upper and middle ones are longest. The specimens are dried, and are from Aden on the Red Sea.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
321	. .	1	Sandwich Islands.	. . . . .	A. Garrett.	Alcoholic.
322	. .	12+	Sandwich Islands.	. . . . .	A. Garrett.	"
323	27	1	Sandwich Islands.	. . . . .	A. Garrett.	Dried.
332	. .	1	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.
333	. .	1	Sandwich Islands.	. . . . .	A. Garrett.	"
433	. .	. .	Java.	. . . . .	Jardin des Plantes.	"
355	. .	. .	Society Islands.	. . . . .	A. Garrett.	"

Ophiocoma brevipes Peters.

Ophiocoma brevipes Peters. Wiegmann's Archiv., p. 84. 1852.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
310	. .	7	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.

OPHIOMASTIX Müll. & Trosch.

Ophiomastix venosa Peters. Wiegmann's Archiv. fur Naturg., p. 84. 1852.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
255	. .	10	Zanzibar.	. . . . .	G. A. Cheney.	Alcoholic.
398	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"
399	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"

OPHIARTHRUM Peters.

Ophiarthrum elegans Peters. Wiegmann's Archiv., p. 84. 1852.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
371	. .	. .	Zanzibar.	. . . . .	C. Cooke.	Alcoholic.
372	. .	. .	Society Islands.	. . . . .	A. Garrett.	"

OPHIACANTHA Müll. & Trosch.

Type of the Genus, *O. spinulosa* Müll. & Trosch.

Disk with little thorny spines. Radial shields covered. Teeth; mouth-papillæ; no tooth-papillæ. Spines numerous, slender, minutely thorny; arranged on the sides of the side arm-plates. Side arm-plates meeting nearly, or quite, above and below. Two genital slits, beginning outside the mouth-shields.

SPECIES HEREIN DESCRIBED.

O. spinulosa.
O. setosa.

Ophiacantha spinulosa Müll. & Trosch. (Figs. 6, 7.)

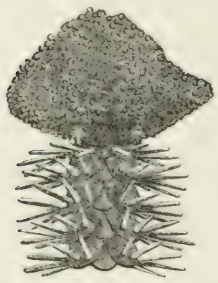
Ophiacantha spinulosa Müll. & Trosch. Syst. Asteriden, p. 107.
Ophiocoma arctica Müll. & Trosch. Syst. Asteriden, p. 103.
Ophiacantha grönlandica Müll. & Trosch. Wiegm. Archiv. fur Naturg., p. 183. 1844.
Ophiocoma echinulata Forbes. Sutherland's Journal. Appendix.
Ophiacantha spinulosa Lütken. Addit. ad Hist. Oph., p. 65.

Special Marks. — Disk evenly covered with short spines.

Description of a Specimen. — Diameter of disk, 9.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 5$^{mm.}$; width of arm without spines, 1.7$^{mm.}$; length of arm, 42$^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 2.1 : 2.6. Mouth-papillæ, six or seven to each angle of mouth; standing well apart; two outermost on each side small, flattened, somewhat rounded, blunt; innermost one sharp, rounded, conical, resembling the lowest tooth, which also might well enough be considered as a mouth-papilla. Teeth seven, thin, rather long, flat, with a rounded cutting edge; lowest one narrowest; uppermost one split in two. Mouth-shields much broader than long; outer side curved, lateral ends pointed; a rounded peak within; length to breadth, .8 : 1.5. Side mouth-shields meeting within, long, slender, of nearly equal width. Under arm-plates squarish, with an angle within, and their outer corners rounded; separated by side arm-plates; length to breadth (seventh plate), .8 : .7. First plate broader than long, and about one half as large as those near it; plates close to tip of arm,

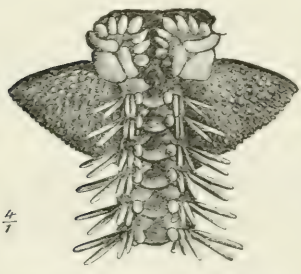
small, shield-shaped, with a regular angle inward, their length less than that of the line of juncture of the two side arm-plates. Side arm-plates large, meeting above and below the whole length of the arm. Upper arm-plates broad triangular, with outer side gently curved, a rounded angle within, and the lateral corners pointed; length to breadth (fifth plate), .7 : 1.4; close to tip of arm, the plates are heart-shaped, and very minute, and bear a very small proportion to the side arm-plates, which cover almost the whole surface. Disk evenly and closely covered, above and below, with short, stout cylinders, ending in a rounded crown of fine thorns; those on the under surface shorter and less thorny; about 20 to a square *mm.* Arm-spines long, slender, slowly tapering, covered with longitudinal rows of microscopic thorns; near the disk eight, farther out seven; lengths to that of under arm-plate (fourth joint), 2, 2, 2, 1.8, 1.5, 1, .8, .8 : .8. One tentacle-scale, longer than broad, rounded at the end; length to that of under arm-plate, .5 : .8. Color, in alcohol: above, light umber; below, paler, except the interbrachial spaces, which are darker.

Fig. 6.



Ophiacantha spinulosa. (Upper side.)

Fig. 7.



Ophiacantha spinulosa. (Lower side.)

Variations. — *O. spinulosa* attains the size of 14$^{mm.}$; the disk spines are then less thorny, and are longer than in the young.

This species has been found at Eastport, Maine; and at Grand Manan Island (twenty fathoms, shelly bottom, Stimpson); Newfoundland (Stuwitz); West Greenland (Rudolph, Olick, Hollböll); Spitzbergen; and on the northwest coast of Norway, from North Cape to the Lofoten Islands, living on corals, nullipores, and ascidia, in from twenty to thirty fathoms (Sars).

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
7	. .	3	. . . . .	. . . . .	Prof. Sars.	Alcoholic.
8	. .	9	Greenland.	. . . . .	Prof. Sars.	"
9	47	3	Greenland.	. . . . .	University Museum, Copenhagen.	"
10	. .	1	Eastport, Me.	July, 1851.	Prof. Agassiz.	"
340	. .	3	Straits of Bellisle.	. . . . .	A. S. Packard, Jr.	"
			Smithsonian Institution.			
1028	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1021	. .	3	Grand Manan Island.	. . . . .	Wm. Stimpson.	"

Ophiacantha setosa Müll. & Trosch.

Asterias setosa Retzius. Dissertatio, p. 30.
Ophiura rosularia Grube (*non* Lamk.). Actin. Echin. u. Wür., p. 20.
Ophiacantha setosa Müll. & Trosch. Syst. Asteriden, p. 106.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
422	. .	. .	Oran, Algeria.	. . . . .	Jardin des Plantes.	Alcoholic.

OPHIOPHOLIS Müll. & Trosch.

Type of the Genus, *O. bellis.*

Disk more or less covered with grains, or little spines. Teeth. No tooth-papillæ. Mouth-papillæ on the sides of the mouth-frames. Arm-spines short, flat, stout, arranged along the sides of the side arm-plates. Upper arm-plates surrounded by a rim of supplementary pieces. The lower spine of the outer arm-joints bearing hooks. General structure rather coarse and stout. Two genital slits beginning outside the mouth-shields.

SPECIES HEREIN DESCRIBED.

Primary plates naked in brachial and interbrachial spaces,	*O. bellis.*
Primary plates naked in brachial spaces only,	*O. Kennerlyi.*
No naked primary plates,	*O. Caryi.*

Ophiopholis bellis Lyman. (Plate I. Fig. 4–6.)

Stella scolopendroides; *bellis scolopendrica* Linck. De Stel. Mar., p. 52, Pl. XL. fig. 71. 1733.
Asterias aculeata O. F. Müll. Zoöl. Dan., p. 29, Pl. XCIX. 1789.
Ophiura bellis Johns. Mag. Nat. Hist., p. 595. 1835.
Ophiocoma bellis Forbes. British Starfishes, p. 53.
Ophiolepis scolopendrica Müll. & Trosch. Syst. Asteriden, p. 96.
Ophiopholis aculeata Lütken. Addit. ad Hist. Oph., p. 60.

Special Marks. — In alcohol, the prevailing tint is brownish-red. Primary plates in the brachial and interbrachial spaces. Disk grains of adult specimens elongated, like short spines.

Description of a Specimen. — Diameter of disk, $20.5^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $7^{mm.}$; width of arm without spines, $3^{mm.}$; length of arm, $142^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 3.1 : 3.6. Mouth-papillæ thin, flat, scale-like, squarish, with rounded corners; six to each angle of the mouth. Teeth twelve, squarish, short, middle of the cutting edge thickened; upper ones growing narrower; two or three lowest ones often split in two. Mouth-shields nearly oval, with a slight point within; length to breadth, 1.5 : 2. Side mouth-shields stout, closely soldered with surrounding parts, meeting within. Under arm-plates somewhat irregular, broader than long, a little separated; inner side

nearly straight, and a little shorter than the outer; outer side nearly straight; outer corners strongly rounded; length to breadth (twelfth plate), 1.2 : 1.7; the first six plates are proportionately longer, and much more rounded, than those beyond; their outer side often has a slightly re-entering curve; at the tip of the arm the plates are longer than broad, with the outer and lateral sides quite straight, and an angle at the inner end. Side arm-plates encroaching a little below, between under arm-plates; cleanly separated from each other by naked skin. Upper arm-plates nearly oval, stout, sometimes broken in two; length to breadth (third plate), 1.2 : 1.9. Supplementary pieces ten or twelve, very closely wedged together, and variously distorted, often broken in two; those on the sides sometimes encroaching between the rows of arm-spines. Near the end of the arm, upper arm-plates nearly round; supplementary pieces bead-like, not crowded. Disk closely beset, above and below, with short, flattened spines, except on the primary plates, and a small space outside the mouth-shields; these spines vary in length, being short and granular towards the middle of the disk and at the bases of the arms, but longer and more closely set in the interbrachial spaces below; their greatest length is about .7$^{mm.}$; primary plates rounded, the middle ones smallest; some of those in the interbrachial spaces often overgrown by spines; the largest ones having a diameter of 1.7$^{mm.}$. Radial shields having the form and appearance of primary plates. Arm-spines six, stout, flattened, cut square off at the end; four upper ones nearly equal, very broad, flat, and square; two lower ones smaller and more conical; lengths to that of lower arm-plate (ninth joint), 1.5, 1.5, 1.5, 1.3, 1.3, 1.1 : 1.2; towards the end of the arm, spines rounded and conical, usually five; lowest spine on tip joints armed with hooks. Tentacle-scale nearly round, stout, flat; length to that of under arm-plate, .6 : 1.2; towards the end of the arm the tentacle-scales are much longer than broad, and are nearly as long as the under arm-plates. Color, in alcohol: above, dull brownish-red (lake and burnt-umber) somewhat variegated; below, interbrachial spaces same as upper surface, but much paler; the rest yellowish.

Variations. — Even in alcohol the coloration is seen to be quite changeable; sometimes the upper surface is uniform dull brownish-red, of different shades in different specimens; or the disk may be nearly white, with reddish arms; or both arms and disk may be mottled reddish and yellowish. Professor Agassiz's colored drawings show that of the living animals scarcely two are alike. The principal patterns are: disk and arms brownish orange, more or less variegated; disk dark green, with a light-green central star, light-green banded arms, and white radial shields; disk and arms indigo blue, variegated with greenish and reddish; disk with a light centre and dark margin, and light-

green arms, banded with lake-red; &c. The very young animals cling to the arms of their parents, sometimes one on top of the other. A young one, with a disk of 1.7mm., had arms 4.4mm. in length; the disk had only a few scattered, small, trifid spines round the margin; in the centre was a rosette of primary plates, which still preserved their form; these were surrounded by twenty-five more plates, viz., a primary plate and two radial shields in each brachial space, and two primary plates in each interbrachial; all the plates were very thin, and composed of a network of fine spiculæ; the upper arm-plates were longer than broad, broadest in front, and rounded throughout; in place of supplementary pieces there were two or three little thorny grains; below, the lower arm-plates were longer than broad, with outer and lateral sides nearly straight, and at the inner end an angle; the mouth-shields and side mouth-shields were much as in the adult; the teeth very few in number; the arm-spines four, very thorny, the lowest one on the outer joints armed with hooks. As the animal grows old, the primary plates become more numerous and more widely separated; the spines of the disk grow smooth and granular, and increase in numbers; then they elongate, and finally become so developed as to obliterate some of the primary plates; the arm-spines, from being slender and conical, become stout and flattened, and the teeth increase greatly in number. Dr. Lütken gives the following table, to show the relative increase of parts.

Diam. of Disk.	Length of Arm.	No. of Joints.	Joints with Hooks.	Joints without Circle of Grains.
2mm.	6mm.	20	15	12
3		40	27	
4		45–50	33	20
6	33	63		
10	60	86		
14	72	105	40–50	18

According to this, both the disk and the arms continue to grow, but the latter the faster. During the growth of the arms new joints are formed, and this increase of joints seems greatest in the very young animal. The new joints appear at the tip of the arm, and not at the base, next the mouth. In moderate sized specimens the arms are usually not more than four or five times longer than the diameter of the disk.

O. bellis is distinguished from *O. Caryi* and *O. Kennerlyi* by greater size and different number of naked primary plates. On the Grand Manan it is abundant, at low-water-mark of the spring tides, among sea-weed (A. E. Verrill). In Boston Harbor the young are often found on bits of floating sea-weed (Dr. Wheatland). On the Scandinavian coasts it has been dredged in from three to sixty fathoms (Hollböll,

&c.). If the "*Ophiocoma*" taken by Dr. Wallich,* on a sounding line, at the astounding depth of 1,250 fathoms, is this species, it has the most extraordinary bathymetrical range.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
165	. .	12+	Grand Manan Island.	Aug. 21, '57.	J. E. Mills.	Alcoholic.
166	. .	12+	Grand Manan Island.	Oct. 2, 1857.	J. E. Mills.	"
167	. .	12+	Grand Manan Island.	Aug. 10, Sep. 29, 30, Oct. 3, '57.	J. E. Mills.	"
168	. .	5	Grand Manan Island.	Sep. 22, '57.	J. E. Mills.	"
169	. .	4	Eastport, Me.	. . . . .	Wm. Stimpson.	"
170	. .	3	. . . . .	. . . . .	Prof. Sars, 1852.	"
171	. .	2	Bergen.	. . . . .	Prof. Sars, 1852.	"
172	. .	6	Greenland.	. . . . .	Prof. Sars, 1852.	"
173	. .	10	Phillips Beach, Mass.	Feb. 14, '48.	Prof. Agassiz.	"
174	. .	4	Nahant ? Mass.	. . . . .	Prof. Agassiz.	"
175	. .	9	Massachusetts ?	. . . . .	Prof. Agassiz.	"
176	. .	12+	Nahant, Mass.	. . . . .	Prof. Agassiz.	"
177	34[a]	3	Norway.	. . . . .	University Museum, Copenhagen.	"
178	34[b]	3	Greenland.	. . . . .	University Museum, Copenhagen.	"
179	34[c]	1	Iceland.	. . . . .	University Museum, Copenhagen.	"
180	34[d]	8	Kattegat and Oresund.	. . . . .	University Museum, Copenhagen.	"
181	34[e] & [f]	10	Greenland.	. . . . .	University Museum, Copenhagen.	"
182	. .	12+	Boston Bay.	. . . . .	Prof. Agassiz.	"
183	. .	12+	Grand Manan Island.	Oct. 5, 1857.	J. E. Mills.	"
184	. .	12+	Eastport, Me.	. . . . .	J. E. Mills.	"
185	. .	1	Fayal ?	. . . . .	Mr. Higginson.	"
186	. .	12	Eastport, Me.	July 1, 1851.	. . . . .	"
187	. .	12	Trenton, Me.	July, 1860.	Messrs. Verrill and Shaler.	"
188	. .	12+	Grand Manan Island.	1859, Sum'er.	A. E. Verrill.	"
189	. .	1	Marked "Florida," but unquestionably wrong.	. . . . .	. . . . .	"
190	. .	5	Massachusetts.	. . . . .	Prof. Agassiz.	Dried.
191	. .	12	. . . . .	. . . . .	. . . . .	"
192	. .	2	Nahant.	. . . . .	Prof. Agassiz.	"
193	. .	12+	Labrador.	. . . . .	Dr. Horatio Storer.	"
194	. .	1	Massachusetts Bay.	. . . . .	. . . . .	"
343	. .	6	Straits of Bellisle.	. . . . .	A. S. Packard, Jr.	Alcoholic.
425	. .	. .	Newfoundland.	. . . . .	Jardin des Plantes.	"
373	. .	. .	Nahant, Mass.	. . . . .	Alex. Agassiz.	"
374	. .	. .	Portland, Me.	. . . . .	. . . . .	"
375	. .	. .	Eastport, Me.	. . . . .	. . . . .	"
376	. .	. .	Grand Manan Island.	. . . . .	. . . . .	"
			Smithsonian Institution.			
1027	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1064	. .	12+	Massachusetts.	. . . . .	Wm. Stimpson.	"

* G. C. Wallich, M. D., on Animal Life at Vast Depths, p. 22. 1860.

Ophiopholis Kennerlyi Lyman.

Ophiopholis Kennerlyi Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 200.

Special Marks. — No naked plates in the interbrachial spaces of the disk, above.

Description of a Specimen. — Diameter of disk, 8mm.; outer edge of mouth-shield to outer corner of opposite mouth-slit, 3.4mm.; width of arm without spines, 2mm.; length of arm, 35.3mm. Mouth-papillæ thin, flat, square, with corners rounded; three on each side. Teeth short, broad, square, stout. Mouth-shields very closely soldered with side mouth-shields, rather small, nearly oval; length to breadth, .7 : 1. Under arm-plates nearly square, corners a little rounded, and outer side bounded by a slightly re-entering curve; length to breadth, 1 : 1. Side arm-plates small, and little prominent. Upper arm-plates irregular oval, sometimes broken in two, more or less encroached on by supplementary pieces, which bound their outer and lateral sides; length to breadth, near base of arm, .8 : 1.5. The supplementary pieces form a close line; they are thick and angular, vary somewhat in size, and, near base of arm, from seven to ten in number; farther out, fewer; and near the tip none at all. Disk, above, closely and evenly covered with round grains, among which appear a few small, round primary plates; one in centre, and one or two in each brachial space; none at all in the interbrachial spaces; diameter of central plate, .7mm.. Disk, below, closely set with short, stout, smooth spines, about .3mm. long. Arm-spines very stout, short, thick, rounded; the longest about length of arm-joints; lowest one much the shortest, blunt, conical; second spine same shape, but longer; third and fourth longest, broad, thick, and blunt; fifth same shape, but shorter; usually five spines; sometimes, close to disk, six; near tip of arm, the lower spine has the form of a double hook. Color, in alcohol: purplish pink, with obscure bands of a darker shade on arms; an obscure line of whitish running lengthwise of the arms; in the position of each radial shield, an irregular patch of white; below, interbrachial spaces mottled reddish and white; mouth-apparatus whitish; lower arm-plates whitish, edged with pink; other parts same as upper surface, but lighter.

Variations. — A specimen of about the same size as the preceding, had usually three, instead of two, primary plates in each brachial space on the upper surface of the disk; also, a distinct line of white, running quite round the disk, near its edge. A young one, with a disk 3mm. in diameter, had arms 12.5mm. in length; the arm-spines were more slender,

and were thorny, as were also the spines and grains of the disk; in the centre of the disk a patch of white, and another at the base of each arm.

This species is interesting, as being the second of a genus which before had but one member. It is distinguished from *O. bellis* by the close and regular granulation of the disk, without spines above, and by having no primary plates in the interbrachial spaces. It seems, also, to be a much smaller species.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
197	. .	1	Mendocino, Cal.	. . . . .	Alex. Agassiz.	Alcoholic.
198	1062	1	Puget Sound.	. . . . .	Dr. Kennerly.	"
			Smithsonian Institution.			
1062	. .	3	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.

Ophiopholis Caryi Lyman.

Ophiopholis Caryi Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 261. 1860.

Special Marks. — Small species; disk about 8$^{mm.}$ in diameter, and closely covered with fine grains, without naked plates.

Description of a Specimen. — Diameter of disk, 8$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.3$^{mm.}$; width of arm without spines, 1.5$^{mm.}$; length of arm, 26.5$^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 1.5 : 1.5. Mouth-papillæ flat, rounded, scale-like, three or four on each side. Teeth about eleven, broad, short, stout, flat, square; uppermost and lowest ones narrower than those in middle; uppermost one longest, with a rounded cutting edge; lowest one often split in two. Mouth-shields irregular, small, usually rounded rhomboidal; length to breadth, .6 : .8. Side mouth-shields nearly meeting within, large and curved, closely soldered with surrounding parts. Under arm-plates a little separated, squarish, with curved lateral sides; outer side slightly re-enteringly curved; inner side rather shorter than the outer, and made up of three short lines, making an angle with each other; length to breadth (eighth plate),

.7 : .6. Upper arm-plates irregular oval, with outer side most curved; length to breadth (third plate), .6 : 1. Supplementary pieces irregular, but usually oblong and angular, the largest ones near lateral corners of each plate; near base of arm, eight or nine to each plate; near the end of the arm there are still eight or nine supplementary pieces, but the upper arm-plates are nearly round. Disk, above, closely and perfectly covered with small rounded grains; about 100 to a square *mm.*; below, interbrachial spaces thickly beset with very short, stout, sharp spines, about .1$^{mm.}$ long. Arm-spines five, sometimes six; short, stout, blunt, more or less flattened; three upper ones largest; second spine stoutest and broadest of all; two lowest smaller and more conical; lengths to that of under arm-plate (eighth joint), .5, .5, .5, .4, .3 : .7; near tip of arm, spines more rounded and tapering. Tentacle-scale one, thin, flat, narrowest at the base, cut off square at the end, about as long as lowest arm-spine. Color, in alcohol: above, nearly uniform lake-pink, a little deeper near edges of disk; along arms a faint, broken line of lighter; below, interbrachial spaces, near edge of disk, same as upper surface, but fading to nearly white towards the mouth; under arm-plates and mouth-parts white, the former edged with reddish along their lateral sides; side arm-plates and arm-spines same as upper surface, but lighter.

Variations. — A young one, with a disk of 2.7$^{mm.}$, had arms 7.6$^{mm.}$ in length; the color was mottled pink and white; the disk was pretty closely covered with grains, or very short spines, each bearing a crown of three little thorns; the arm-spines were rounded and conical, but not at all flattened. Another specimen had a disk of only 2.2$^{mm.}$, and arms of 8.1$^{mm.}$; this had all the supplementary pieces of the upper arm-plates covered with minute thorns. The smallest specimen had a disk of 1.9$^{mm.}$, and arms of 5.4$^{mm.}$; the disk granulation, arm-spines, mouth-papillæ, and supplementary pieces of the arm-plates, were all thorny; arm-spines five; mouth-papillæ two; lower arm-plates longer than broad, narrowest within, with a re-entering curve on the outer side, and a notch on the inner; upper arm-plates longer than broad, rounded.

This small species is distinguished from *O. Kennerlyi* and *O. bellis* by having the disk entirely covered with fine grains, without naked plates.

It is not impossible that this may be but a variety of *O. Kennerlyi;* but as I have seen the *young* of both, with the distinctive specific marks, I prefer to keep the names as they now stand.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
195	. .	12+	Mendocino, Cal.	. . . . .	Alex. Agassiz.	Alcoholic.
196	. .	4	San Francisco, Cal.	. . . . .	T. G. Cary.	"

OPHIOSTIGMA Lütken.

Type of the Genus, *O. isacanthum* Lyman.

Disk granulated. Teeth. No tooth-papillæ. Basal mouth-papillæ very long, stout, and broad; the others small and few, arranged so as to cover the end as well as the sides of the angle of the mouth. Arm-spines three, short, smooth, arranged along the sides of the side arm-plates. Side mouth-shields large; nearly, or quite, touching, so as to form a ring round the mouth. Mouth-apparatus, as a whole, forming a distinct, raised pentagon. Two genital slits, beginning outside the mouth-shields.

Ophiostigma isacanthum Lyman. (Figs. 8, 9.)

Ophiura isacantha Say. Journ. Phil. Acad., V. p. 150. 1825.
Ophiostigma moniliforme Lütken. Addit. ad Hist. Oph., p. 132.

Special Marks. — Upper arm-plates cleanly arched without; lower arm-plates bounded within by an inner side and two inner laterals.

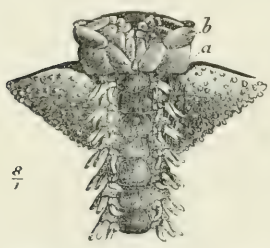
Description of a Specimen. — Diameter of disk, $5^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $2.1^{mm.}$; width of arm without spines, $.8^{mm.}$; length of arm, $23.5^{mm.}$; distance from outer edge of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 1 : 1.2. Mouth-papillæ, four to six. Teeth four, stout, short, squarish, with the cutting edge a little re-enteringly curved. Mouth-shields broad heart-shaped, with a sharp peak within,

outer side curved, and inner sides re-enteringly curved; length to breadth, .5 : .7. Side mouth-shields wider without than within, touching each other within for their whole breadth. Under arm-plates squarish, broader than long; bounded without and on the two lateral sides by nearly straight lines; within by an inner side and two inner laterals; length to breadth (ninth plate), .3 : .5; first under arm-plate diamond-shaped, and very small. Side arm-plates encroaching between the upper and under plates, but more between the former. Upper arm-plates oval diamond-shaped, cleanly curved without, somewhat pointed at the lateral corners, and with a rounded angle within; length to breadth (fifth plate), .3 : .7. Spines of disk very short and blunt, like elongated grains; standing, not close, but evenly. The outer ends of the radial shields are indicated by slight swellings. Arm-spines short, blunt, little tapering, evenly rounded, of nearly equal lengths; upper one a trifle the stoutest; length to that of under arm-plate, .4 : .3. Tentacle-scales two, rather stout, longer than broad, inside one larger. Color, when dry, white.

Fig. 8.

Ophiostigma isacanthum. (Upper side.) *m*, radial scale.

Fig. 9.



Ophiostigma isacanthum. (Lower side.) *a*, mouth-shield; *b*, side mouth-shield.

Variations. — Dr. Lütken mentions a six-armed specimen. He speaks of the color as commonly variegated brown, and mentions one black individual. Say, on the contrary, described his specimen as white, with green bands on the arms. An alcoholic specimen in the Cambridge Museum is light brown. The arms seem commonly to be from four to six times as long as the diameter of the disk.

This rare species is said to be distinguished from *O. tenue* by the form of the under arm-plates. It has been taken at St. Thomas, in four fathoms of water (A. H. Riise); at St. John (Professor Prosch); and in Florida (Professor Agassiz).

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
252	. .	1	Florida.	. . . . .	Prof. Agassiz.	Alcoholic.
253	. .	1	Cape Florida.	. . . . .	G. Wurdeman.	"
254	. .	1	Florida.	. . . . .	Prof. Agassiz.	Dried.

OPHIACTIS Lütken.

Type of the Genus, *O. Krebsii.*

Disk circular, robust, closely covered with radial shields and overlapping scales, the latter bearing a greater or less number of small spines. Teeth. No tooth-papillæ. A few (usually two or four) small, delicate mouth-papillæ to each angle of the mouth, situated near the outer corner of the mouth-slit. Arm-spines arranged along the sides of the side arm-plates. Two genital slits beginning outside the mouth-shields.

GROUPING OF SPECIES HEREIN DESCRIBED.

Five arms in the adult,	Two mouth-papillæ,	Radial shields separated and very small; side mouth-shields broad, and making a continuous ring round the mouth,	*O. simplex.*
		Mouth-shields much broader than long; arm-spines smooth, tapering, differing much in length,	*O. Kröyeri.*
		Arm-spines very short, blunt, rough; nearly equal,	*O. Mülleri.*
Six arms in the adult,	Four mouth-papillæ.	A slight lobe on the outer side of the upper arm-plate,	*O. Krebsii.*
			O. virescens.
			O. sexradia.

Ophiactis simplex Lütken.

Ophiolepis simplex Le Conte. Proceed. Phil. Acad., V. p. 318. Nov., 1851.
Ophiactis (*Ophiolepis*) *simplex* Lütken. Addit. ad Hist. Oph., p. 130.
Ophiactis Örstedii? Lütken. Addit. ad Hist. Oph., p. 129.
Ophiactis arenosa? Lütken. Addit. ad Hist. Oph., p. 129.

Special Marks. — Radial shields widely separated, and comparatively small; spines very numerous in the lower interbrachial spaces; disk-scales inclining to a circular form, rather regular.

Description of a Specimen. — Diameter of disk, $4^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $1.7^{mm.}$; width of arm without spines, $1.1^{mm.}$; length of arm about $28^{mm.}$; distance from

outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 1 : .9. Mouth-papillæ, two to each angle of mouth, situated near outer end of mouth-slit, about as broad as long, thin, angular. Cutting edge of teeth re-enteringly curved. Mouth-shields broader than long, nearly oval, with a slight peak within; length to breadth, .4 : .5; madreporic shield much larger. Side mouth-shields very large, about as broad as the length of the mouth-shields, re-enteringly curved at the outer corners of the mouth-slits; meeting fully within, and also touching their neighbors without, so as to cover the first under arm-plate. Under arm-plates even, a little overlapping, about as broad as long, rather thick; outer side cleanly curved, laterals short and nearly straight; within there are an inner side and two inner laterals, which are short and nearly equal, and are often more or less combined in a broken curve; length to breadth (tenth plate), .5 : .4. Side arm-plates small, making a narrow, prominent ridge for the arm-spines. Upper arm-plates regular, a little overlapping, much broader than long; bounded without and within by straight lines, and on the sides by curves; a little narrower within than without; first two or three plates much shorter than those beyond; length to breadth (seventh plate), .5 : 1. Disk-scales pretty regular and rounded, and rather thick; in the centre a conspicuous primary plate, with an indistinct rosette about it; in each interbrachial space a radiating, connected row of rounded primary plates, between which and the radial shields there are two or three pretty regular rows of smaller scales, about 16 to a square *mm.* Radial shields small, pointed within, widely separated by a wedge of different sized scales; length to breadth, .8 : .4. Along edge of disk, and on interbrachial spaces below, numerous short spines, of which there are also a few scattered about the back of the disk. Arm-spines five, only moderately stout; round, tapering, blunt, slightly rough; three middle ones longest, lowest one shortest; lengths to that of under arm-plate (sixth joint), .3, .4, .4, .4, .2 : .4. Tentacle-scale much longer than broad, nearly oval, more than half as long as the under arm-plate. Color, dry: above, and interbrachial spaces below, very dark olive-green; rest of lower surface yellowish.

Variations. — Of fourteen specimens that I have examined, the two largest had only five arms; the rest, which were much smaller, had six; except one small specimen, which had but four. A young one had the following characters: diameter of disk, 1.2$^{mm.}$; length of arm, 4.2$^{mm.}$. Upper arm-plates, most of them, separated by side arm-plates, heart-shaped, somewhat swollen; disk covered with large, rounded, swollen scales, of which the eight middle ones form a rosette; radial shields not conspicuous, and smaller than most of the disk-scales; a very few minute spines on the disk; arm-spines four, more slender than in the

adult; under arm-plates pentagonal, with an angle inward; longer than broad, nearly separated by side arm-plates; two full arm-joints admitted into the disk. The proportions of the disk to the arms may be as follows: 1.2 : 4.2, 1.6 : 6, 2.5 : 15, 4 : 28. The color of the young, when dry, is tawny brown, the arms being barred with greenish brown; as they grow larger, the tendency of tint is more towards greenish. Dr. LeConte says the color of the living animal is "pale beneath, above blackish brown; arms marked with a few paler bands." He adds, that "the scales are *all* finely granulated" (spinous), so that, in the dried specimens, these spines have probably for the most part been rubbed off.

It is probable that the adult of this species has always five arms, while the young have six. It is easily distinguished by its small radial shields, which, together with the form of its arm-spines and upper arm-plates, place it nearer to *Amphiura* than are the other species of *Ophiactis*. I feel pretty sure that *O. Örstedii*, of which Dr. Lütken got one specimen, through Dr. Örsted, from Puntarenas, is the same as this species. The only noteworthy difference is in the shortness of the arms, which were apparently broken in the above-mentioned specimen, and could not therefore be accurately measured. It is also possible that *O. arenosa* Ltk. will fall among the synonymes of *O. simplex*. But these questions must be answered by future observers.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
225	1198	1	Panama.	. . . . .	Dr. J. LeConte.	Dried.
			Smithsonian Institution.			
1198	. .	12+	Panama.	. . . . .	Dr. J. LeConte.	Dried.
? 1186	. .	2	West Coast Nicaragua.	. . . . .	Capt. Dow.	"

Ophiactis Kröyeri Lütken.

Ophiactis Kröyeri Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiactis Kröyeri Lütken. Addit. ad Hist. Oph., p. 130.

Special Marks. — Mouth-shields much broader than long, with a peak within and a small tail without. Six (or five) arm-spines, all smooth; fourth (or third) from the top much the longest.

Description of a Specimen. — Diameter of disk, $5^{mm.}$; from outer side of mouth-shields to outer corner of opposite mouth-slit, $2.5^{mm.}$; width of arm without spines, $1.5^{mm.}$; length of arm about $25^{mm.}$; distance from outer side of mouth-shields to inner points of teeth, to that between outer corners of mouth-slits, .9 : 1.4. Mouth-papillæ, two to each angle of jaw, thin, wider than long, with a bevelled, cutting edge. Teeth nine, short, thick, stout, and crowded; third and fourth from below broadest; uppermost one smallest and narrowest. Mouth-shields much broader than long, with a little tail or peak without, and a rounded peak within; lateral corners rounded; length to breadth, .5 : .9. Side mouth-shields small, narrow, irregularly triangular, not meeting within; they are unusually variable in size and shape. Under arm-plates without sharp angles, broader than long, outer side and corners curved, lateral sides nearly straight, inner side strongly curved, forming sometimes a rounded angle; first plate short and very small, often separated from second plate by side mouth-shields; next three or four plates smaller than those immediately beyond; length to breadth (eighth plate), .6 : 1. Side arm-plates projecting strongly, encroaching a little below. Upper arm-plates a good deal broader than long, squarish; outer and lateral sides nearly straight, inner side slightly curved; corners a little rounded; length to breadth (twelfth plate), .6 : 1; the first two or three plates are smaller and oval. Disk-scales much crowded, varying somewhat in length, but of nearly the same size; about 12 to a square *mm.*; in the middle is a single primary plate, and there is a connected, radiating row, of three or four plates, in each interbrachial space; along margin of disk, a good number of small, stout, conical spines, about $.3^{mm.}$ long; there are a few others scattered on upper surface of disk, and some on the interbrachial spaces below. Radial shields swollen, long triangular, with their points inward; where they are joined, without, there is a slight lobe; for the rest of their length they are separated by a stout wedge of one, two, or three scales; length to breadth, 1.5 : .8. Arm-spines, near base of arm, six, very smooth, rounded, hardly tapering, blunt and rounded at the point; uppermost and lowest spines shortest, fourth from the top the longest, others inter-

mediate in length; lengths to that of under arm-plate (ninth joint), .5, .8, .9, 1.4, .8, .6 : .6; near tip of arm, only four spines, which are nearly equal. Tentacle-scale stout, nearly round, rather large; length to that of under arm-plate, .3 : .6. Color, in alcohol: light gray.

O. Kröyeri is easily distinguished by the shape of its upper and under arm-plates, and by its six smooth spines, of which the fourth is much the longest.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
436	. .	. .	Callao.	. . . . .	Jardin des Plantes.	Alcoholic.
			Smithsonian Institution.			
1024	. .	1	Callao.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Ophiactis Mülleri LÜTKEN.

Ophiactis Mülleri LÜTKEN. Additamenta ad Hist. Oph., p. 127.

Special Marks. — One mouth-papilla, usually six arms; upper arm-plates regular oval; near the edge of the disk a few spines.

Description of a Specimen. — Diameter of disk, 3.3$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 1.5$^{mm.}$; width of arm without spines, .8$^{mm.}$; length of arm, 17$^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, .7 : .6. Mouth-papillæ, one on each side, placed near outer corner of mouth-slit; thin, flat, rounded. Teeth four, longer than broad, crowded; cutting edge wavy; lowest tooth smallest; between it and the lower end of the jaw there is a vacant space, without any teeth or papillæ. Mouth-shields a little variable, usually broad diamond-shape, with angles more or less rounded; length to breadth, .3 : .3. Side mouth-shields more than half as large as mouth-shields, stout, rather broad; not meeting within, but sometimes touching their next neighbors at the outer end of mouth-slit. Under arm-plates, near base of arm, short, rounded, heart-shape, with a more or less distinct angle inward; farther out on the arm they become more angular, and are bounded within by a distinct angle, without by an outer side and two

short outer laterals, and on the sides by straight laterals, all the corners being somewhat rounded; length to breadth (eighth plate), .4 : .4. Side arm-plates stout, regular, encroaching a little below. Upper arm-plates cleanly and regularly oval, stout, but not swollen, slightly overlapping; length to breadth (third plate), .4 : .7. Disk-scales, near the margin, about 50 to a square *mm.*; considerably smaller below, but larger near the centre, above; a very uneven rosette of primary plates in the middle of the disk, and usually one elongated plate in each brachial and interbrachial space; near edge of disk, a few very short spines. Radial shields either touching for their whole length, except their inner points, or else more or less separated by one or two very narrow scales; length to breadth, .9 : .4. Arm-spines four, second one from the top much the stoutest and roughest, lowest one smallest, the other two intermediate in size; all are nearly cylindrical, and somewhat tapering; lengths to that of under arm-plate (eighth joint), .3, .4, .3, .2 : .4. Tentacle-scale one, very similar in shape and size to the mouth-papillæ. Color, in alcohol: upper surface and interbrachial spaces below variegated with sap-green, dull cobalt blue and white, the principal tint being green; remainder of under surface nearly white. The color is about the same in the living animal.

Variations. — The above-described specimen had only five arms, but, as a rule, the number is six, and of these two or three are almost always smaller than the rest. The arms vary much in number; occasionally a specimen may be seen with only *one*. A young one had five arms about $3.5^{mm.}$ long, the diameter of the disk being $1.2^{mm.}$; lower arm-plates long pentagonal, with an angle inward; upper arm-plates broad heart-shape, with a curved outer side, and straight inner laterals; they had a peak within, and were completely separated by the encroachment of the side arm-plates; upper side of disk without any spines, and covered by the radial shields, and a few large, irregular scales, some of which formed a sort of rosette in the centre. It is said that there are sometimes five arm-spines, but I have never seen more than four; and many of the basal joints have but three.

O. Mülleri may be recognized by its single mouth-papilla, oval upper arm-plates, and six arms.

It has been found abundantly at St. Thomas (A. H. Riise). At Cape Florida I found great numbers, living in colonies, at low-water-mark. The little animals were clinging to a kind of spreading, greenish sponge, which grows like a thick net-work, and often attains a thickness of a foot, and a diameter of four or five feet.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
215	. .	12+	Cape Florida.	Feb. 1856.	T. Lyman.	Alcoholic.
216	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
217	. .	2	Florida.	. . . . .	G. Wurdeman.	"
218	60	6	West Indies.	. . . . .	University Museum, Copenhagen.	"
			Smithsonian Institution.			
1015	. .	1	West Indies.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1157	. .	5	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1083	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1110	. .	5	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

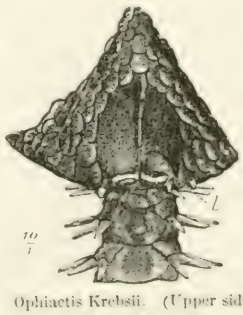
Ophiactis Krebsii LÜTKEN. (Figs. 10, 11.)

Ophiactis Krebsii LÜTKEN. Addit. ad Hist. Oph., p. 126.

Special Marks. — Commonly six arms and five arm-spines. A very slight lobe on the outer side of the upper arm-plates. Four mouth-papillæ to each angle of the mouth.

Description of a Specimen. — Diameter of disk, 3.3$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 1.6$^{mm.}$; width of arm without spines, .9$^{mm.}$; length of arm, 19$^{mm.}$; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, .8 : .8. Mouth-papillæ, four to each angle of the mouth, flat, thin, rounded, longer than broad. Teeth six, uppermost one tapering and a little the longest; the rest flat, squarish, longer than broad, with a cutting edge thickened at its middle point. Mouth-shields much rounded diamond-shape, with a little tail on the outer side; length to breadth, .4 : .3. Side mouth-shields stout, barely meeting within. Under arm-plates about as long as broad, octagonal, the inner lateral sides being longest; length to breadth (tenth plate), .4 : .4. Side arm-plates encroaching a little below, projecting laterally a good deal. Upper arm-plates oval, thick, slightly swollen, with a very small lobe on the outer

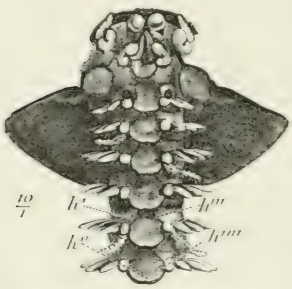
Fig. 10.



Ophiactis Krebsii. (Upper side.)
l, radial shield.

side; this lobe is not so distinct on the basal plates as on those a little farther out on the arm; length to breadth (eighth plate), .4 : .7. Scales of disk all pretty small and thin, very irregular; no rosette of primary plates in the middle, but sometimes a single primary plate may be distinguished in the interbrachial spaces; scales near the margin, about 60 to a square *mm.*; scales of interbrachial spaces, below, very fine. Radial shields regular, elongated, pear-seed shape, partially separated by one or two narrow scales; length to breadth, 1 : .4. There are a few scattered, short spines along the disk margin, and also towards the centre. Arm-spines five, near the disk six; rounded, somewhat tapering; second one from the top largest; first and third of about the same size; the rest growing smaller to the lowest one; lengths of second and sixth spines to that of under arm-plate (fifth joint), .4, .2 : .6. Tentacle-scale one, similar to the mouth-papillæ. Color, in alcohol: variegated bright sap-green and whitish; radial shields green, tipped with white; arms banded green and white.

Fig. 11.



Ophiactis Krebsii. (Lower side.)

h' h''', inner lateral sides of under arm-plates; h'', outer side; h'''', lateral side.

Variations. — Not so many individuals have only two or three arms as in *O. Müllerí;* the usual number is six. A young one had the following characters: diameter of disk, 1.5$^{mm.}$; length of arms, 6$^{mm.}$; upper arm-plates triangular, with a more or less sharp angle, turned inward, not separated by side arm-plates; under arm-plates longer than broad, with an angle within, lateral and outer sides nearly straight, corners rounded; otherwise it resembles the adult, even to the number of the arm-spines. A large specimen had a disk of 4.2$^{mm.}$, and arms of 20$^{mm.}$. The disk is said to grow as large as 7$^{mm.}$. The side mouth-shields commonly meet within.

This species is common at St. Thomas (A. H. Riise, Mr. Krebs) and at Santa Cruz (Mr. Örsted); I have found it at Cape Florida; Rev. J. E. Mills, at Key West; and Professor Agassiz has dredged it as far north as Charleston, S. C., outside the bar of the harbor. It lives on corals and sponges, and has been found from low-water-mark to three fathoms. It may be distinguished from its six-armed neighbor, *O. Müllerí*, by having four mouth-papillæ instead of two, and having a slight lobe on the outer edge of the upper arm-plate; and from *O. virescens*, to which it stands very near, by regularly tapering arms and somewhat narrower upper arm-plates.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
219	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
220	. .	1	Cape Florida.	Feb. 1856.	Theo. Lyman.	"
221	. .	1	Key West, Fla.	Mh. 6, 1858.	J. E. Mills.	"
222	. .	4	Charleston, S. C.	. . . . .	Prof. Agassiz.	"
223	59	1	West Indies.	. . . . .	University Museum, Copenhagen.	"
224	. .	1	Bahamas.	. . . . .	Dr. H. Bryant.	"
			Smithsonian Institution.			
1020	. .	1	West Indies.	. . . . .	University Museum, Copenhagen.	Alcoholic.
1156	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1109	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophiactis virescens Örsted & Lutken.

Ophiactis virescens Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiactis virescens Lütken. Addit. ad Hist. Oph., p. 128.

Special Marks. — In well-grown specimens, the arm is suddenly swollen near the disk. Arm-spines very thick; two uppermost usually largest. Upper arm-plates twice as broad as long, with a distinct lobe without.

Description of a Specimen. — Diameter of disk, 3.8$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 1.6$^{mm.}$; width of arm without spines, 1.1$^{mm.}$; length of arm, 15$^{mm.}$; distance from outer side of mouth-shields to inner points of teeth, to that between outer corners of mouth-slits, .9 : .9. Mouth-papillæ, four to each angle of mouth; thin, flat, longer than broad. Teeth six, squarish, flat; lowest and uppermost one smallest; those below thicker than upper ones. Mouth-shields much rounded diamond-shape, with a point within, and often a little tail without; length to breadth, .4 : .3. Side mouth-shields very long and much bent; they meet within, and run side by side a little way, towards the teeth; their outer ends meet those of their neighbors, so as to cover the first under arm-plate. Under arm-plates about as long as broad, octagonal, the inner laterals being usually a little longer than the other sides; length to breadth (eighth plate), .5 : .4. Upper arm-plates oval, much broader than long, with a decided lobe on outer side; length to breadth (ninth plate), .5 : 1; first four or five plates not so broad as those immediately beyond, because the arm

is much narrower at its base than it is a little way out. Disk-scales less crowded and somewhat more regular than is common in the genus; there are about three parallel, radiating rows of rounded scales in the narrowest part of each interbrachial space; a few short spines are scattered here and there. Radial shields very straight along the side next their neighboring shield, but much curved along the side next the interbrachial space; length to breadth, 1.1 : .6; they are separated for nearly their whole length by a wedge of three long scales. Arm-spines near base of arm, five; two upper ones commonly thickest and largest; all of them very short, thick, rough, blunt, and a little tapering; lengths to that of under arm-plate, .5, .5, .4, .3, .2 : .5. Tentacle-scale flat, thin, broader than long, rounded at the end, resembling a mouth-papilla, but larger. Color, in alcohol: above, radial shields dark sap-green, tipped on their outer ends with lighter; rest of disk mottled with darker and lighter sap-green; arms banded and mottled with the same; below, mouth-parts and under arm-plates yellowish or greenish white.

Variations. — The color varies in intensity and somewhat in pattern. Sometimes the radial shields are not separated. A smaller one, with a disk of 2.7^{mm}, had arms about four times as long; the upper arm-plates were proportionately not so wide; the lower plates more rounded, and inclining to an angular heart-shape; the disk spines were pretty numerous, and longer than in larger specimens.

O. virescens is very like *O. Krebsii*, but differs in having the arm suddenly swelled, a little way from the disk, instead of regularly tapering; the arm-spines, also, are rather more rounded, thicker, and blunter, and the upper arm-plates proportionately a little wider, with a stronger outer lobe.

The first specimens were found at Realejo, in three fathoms of water, and at Puntarenas, by Dr. Örsted; others have since been sent from Cape St. Lucas by Mr. Xantus.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
226	1166	1	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.
			Smithsonian Institution.			
1166	. .	5	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.

Ophiactis sexradia Lütken.

Ophiolepis sexradia Grube. Wiegmann's Archiv., p. 342. I. 1857.
Ophiactis sexradia Lütken. Addit. ad Hist. Oph., II. p. 126.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
227	. .	12+	Sandwich Islands.	. . . . .	A. Garrett.	Alcoholic.
403 sp.?	. .	. .	Zanzibar.	. . . . .	. . . . .	"

AMPHIURA Forbes.

Type of the Genus, *A. filiformis.*

Disk small and delicate, covered with naked, overlapping scales, and furnished with uncovered radial shields. Teeth. No tooth-papillæ. Six (rarely eight) mouth-papillæ to each angle of the mouth. Arms slender, even, more or less flattened. Arm-spines short and regular, arranged along the sides of the side arm-plates. Two genital slits to each interbrachial space.

GROUPING OF SPECIES HEREIN DESCRIBED.

Arms long and slim; middle arm-spine with a cross-piece at the end, — *A. filiformis.*

Arms very slim and of great length (often twenty-four times as long as diameter of disk), tapering only at their tips; outer mouth-papilla broadest; radial shields very long and narrow, — *A. gracillima.*

One mouth-papilla placed above the rest; radial shields long and narrow, — *A. Hollölli.* *A. Chiajii.*

Outer mouth-papilla broadest; under arm-plates pentagonal; arms of moderate length (about eight times the diameter of the disk), — *A. geminata.*

Outer mouth-papilla much the broadest; under arm-plates pentagonal; side mouth-shields large and meeting within, — *A. squamata.* *A. tenera.* *A. pugetana.*

Under arm-plates broader within than without, — *A. atra.*

Some of the disk-scales with toothed edges, — *A. urtica.*

Mouth-papillæ equal, separated; under arm-plates square; upper arm-plates large, overlapping, wider without than within, with rounded outer corners, — *A. occidentalis.*

Amphiura filiformis Forbes.

Asterias filiformis O. F. Müller. Zoöl. Dan. Prodr. 1776.
Ophiura filiformis Lamk. Hist. Anim. sans Vertèb., II. p. 546. 1816.
Amphiura filiformis Forbes. Linn. Trans., XIX. p. 151. 1843.
Ophiolepis filiformis Müll. & Trosch. Syst. Asteriden, p. 94. 1842.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
235	37	3	Oresund.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Amphiura gracillima Lütken.

Ophiolepis gracillima Stimpson. Proceed. Boston Soc. Nat. Hist., IV. p. 224.
Amphiura (Ophiolepis) gracillima Lütken. Addit. ad Hist. Oph., p. 117.

Special Marks. — Arms slender, not tapering till near the tip, often twenty-four times as long as the diameter of the disk; mouth-shields angularly ovoid, long; side mouth-shields not meeting within.

Description of a Specimen. — Diameter of disk, $6^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $2^{mm.}$; width of arm without spines, $.6^{mm.}$; length of arm about $140^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.1 : 1. Mouth-papillæ, three on each side, outermost one much the largest, stout, longer within than without; innermost one running upwards to the teeth, stout, rounded, bead-like; middle one similar in size and shape. Teeth seven, longer than broad, stout, squarish, thickened at the middle point of the cutting edge; uppermost one longest. Mouth-shields longer than broad, five-sided, presenting a rounded angle without; narrower within than without; length to breadth, .6 : .4. Side mouth-shields small, short, irregularly triangular, lying on the sides of mouth-shields, and not meeting within. Under arm-plates a little broader than long, squarish, with rounded corners; near base of arm, touching each other, but not overlapping; length to breadth (sixth plate), .3 : .4; about two thirds out on arm, the plates are nearly separated by side arm-plates, and are pentagonal, with a sharp angle within; lateral sides nearly straight, and

outer side re-enteringly curved; length, .3[mm]. Side arm-plates with a decided ridge for support of arm-spines, encroaching above, even at base of arm; and below also, farther out on arm. Upper arm-plates much broader than long, pointed oval, more curved within than without, having a slight median ridge; length to breadth (twelfth plate), .3 : .7; about two thirds out on arm, plates broader than long, bounded without by a nearly straight line, within by a strong arch; overlapping each other slightly, and set closer together than those nearer the base of the arm. Disk-scales minute; above, varying somewhat in size, being larger near radial shields; from 144 to 225 to a square *mm.*; below, rather smaller. Radial shields sunken, very long and narrow, joined for their whole length, their inner ends buried in the disk-scales; length to breadth, 1.4 : .2. Arm-spines four, close to the disk five, short, slender, rounded, tapering, sharp, nearly equal; third spine a trifle the longest; length to that of under arm-plate, .4 : .3. Tentacle-scales two, wide, short, thin; the inside one running along lateral side of under arm-plate, the outside one standing at right angles to it. Color, in alcohol: pale brownish.

Variations. — The mouth-shields vary somewhat, but always have an angular, ovoid outline. The living animal has the disk dark gray above, with black radial shields, and a central fawn-colored spot; first three arm-joints edged with black; the rest either black or dark or light gray; along the median line of the arm, above, an interrupted white line. Found at low water, six inches deep in soft mud; it throws up one arm to the surface (Stimpson).

This species is easily told by its immensely long, slender, and even arms, with slim, stout, tapering spines on their sides.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
245	. .	1	Fort Johnson, Charleston, S. C.	. . . . .	Wm. Stimpson.	Alcoholic.
			Smithsonian Institution.			
1029	. .	1	South Carolina.	. . . . .	Wm. Stimpson.	Alcoholic.

Amphiura Holbölli Lütken.

Amphiura Holbölli Lütken. Vidensk. Meddelelser. Nov., 1854.
Amphiura Holbölli Lütken. Addit. ad Hist. Oph., p. 55.

Special Marks. — Middle mouth-papilla placed higher than the others; one tentacle-scale; under arm-plates pentagonal.

Description of a Specimen. — Diameter of disk, 7.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.3$^{mm.}$; width of arm without spines, 1.4$^{mm.}$; length of arm, 30$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.7 : 1.5. Mouth-papillæ, six to each angle of mouth; two innermost stoutest, pointing to centre of mouth, oblong; running upwards to the teeth; innermost papilla attached to side mouth-shield, small, flat, with a curved, cutting edge; middle papillæ placed near the innermost one, and a little higher up; long, sharp, like a canine tooth. Teeth four; two uppermost large, flat, longer than broad, squarish, rather thick; next one smaller, stouter, sharper; lowest one very short and thick, presenting a broad, grinding surface. Mouth-shields rounded, truncated, and narrower without; length to breadth, .7 : .7; madreporic shield nearly twice as large as the rest, and bearing pores on its edge. Side mouth-shields large, broad triangular, with all their sides re-enteringly curved; meeting within, and also meeting their neighbors between the first and second under arm-plates. Under arm-plates about as long as broad, regularly pentagonal, the fifth angle being very obtuse, and directed inwards; length to breadth (thirteenth plate), .6 : .5; first plate nearly hidden by side mouth-shields. Side arm-plates narrow, encroaching so as almost to meet both above and below. Upper arm-plates broader than long, pointed oval, more curved within than without, the inner curve making a faint angle; length to breadth (sixth plate), .6 : 1.2. Disk-scales about 20 to a square *mm.*; some of the primary plates, especially those in the centre, still to be distinguished; scales of interbrachial spaces below much finer. Radial shields small, narrow oval, with inner end pointed; length to breadth, 1.2 : .5; widely separated from each other by a broad wedge of scales. Arm-spines three, near the disk four, nearly equal, stout, nearly cylindrical, blunt, hardly tapering; upper one rather the stoutest and most tapering; lengths to that of under arm-plate (tenth joint), .6 : .6. Tentacle-scale one, small, rounded, standing within the tentacle pore. Color, in alcohol: disk, brownish gray; arms the same, but browner.

Variations. — A small specimen had a disk of 4mm., and arms of 14.5mm.; the primary plates were very large, rounded, and distinct; the upper arm-plates were proportionately longer and more angular than in the adult; there were four arm-spines, which were more tapering than in larger specimens. Sometimes the inner angle of the under arm-plates is nearly obliterated. The side mouth-shields often do not quite meet in the interbrachial spaces. Color of the living animal, whitish.

Taken off the coast of Greenland; muddy bottom; fifteen to fifty fathoms (Barrett).

The displaced middle mouth-papilla is a good distinguishing mark in this species.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
236	38	2	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.
			Smithsonian Institution.			
1031	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Amphiura Chiajii Forbes.

Asterias filiformis Delle Chiaje (*non* O. F. Müller). Memorie, II. p. 359. 1825.
Amphiura Chiajii Forbes. Linn. Trans., XIX. p. 151. 1843.
Amphiura Chiajii Sars. Middelhav. Lit. Fauna, II. p. 86. 1857.
Amphiura Chiajii Lütken. Addit. ad Hist. Oph., p. 57.
Ophiolepis Sundevalli Müll. & Trosch. Syst. Asteriden, p. 93.

There are, at Berlin, specimens labelled *Ophiolepis Sundevalli*, apparently in the writing of Joh. Müller (Anat. Mus., 16498). They were sent from Norway by Professor Sars, and are plainly the same as *A. Chiajii*. The two synonymes are contemporaneous; but *A. Chiajii* is here retained as the name in use among the best authors.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
233	36	1	Norway.	. . . . .	University Museum, Copenhagen.	Alcoholic.
234	. .	. .	. . . . .	. . . . .	Prof. Sars, 1852.	"

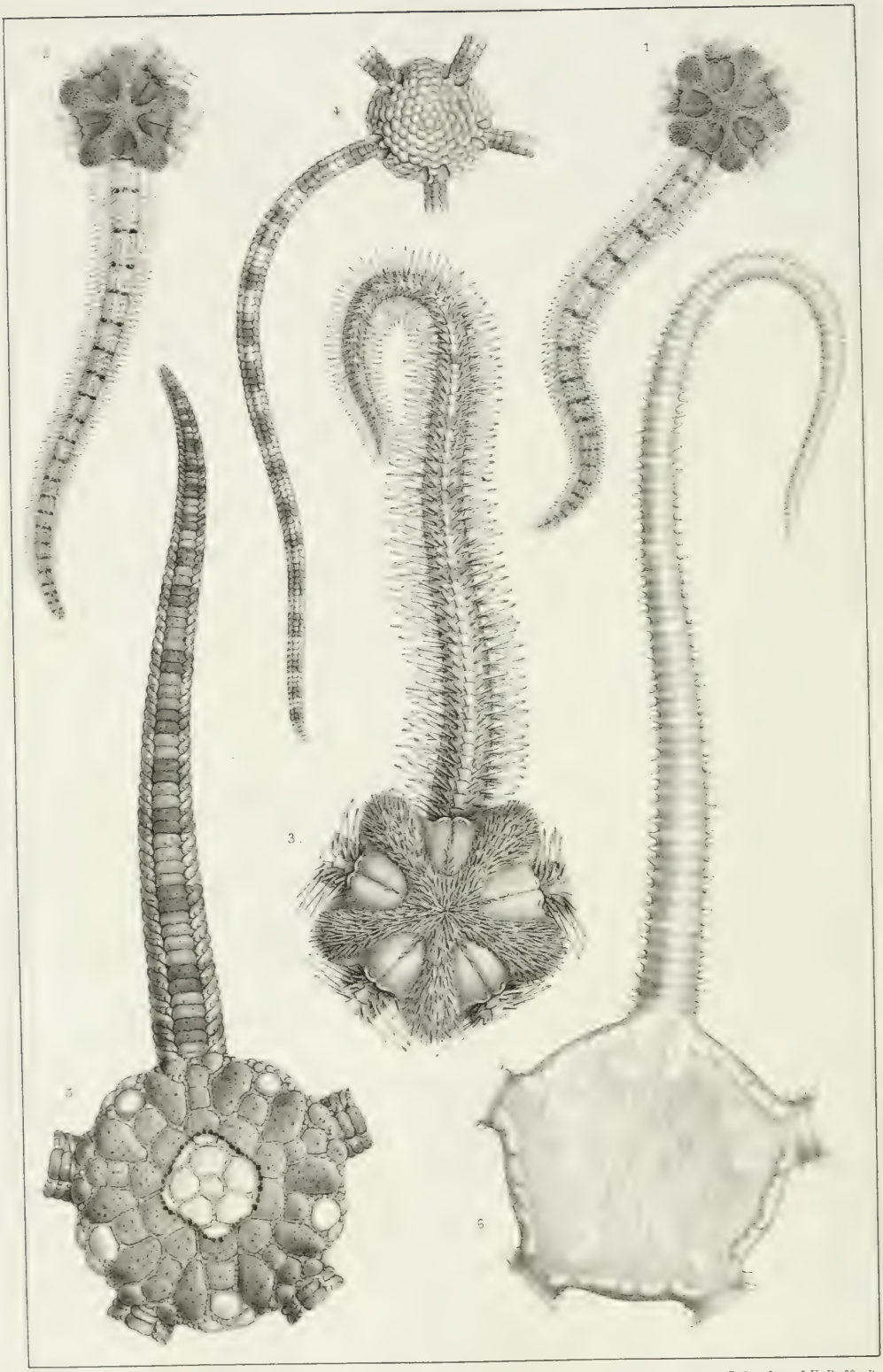
Amphiura geminata Lütken.

Ophiolepis geminata LeConte. Proceed. Phil. Acad., V. p. 317. 1851.
Amphiura (*Ophiolepis*) *geminata* Lütken. Addit. ad Hist. Oph., p. 122.

Special Marks. — Arm-spines, near disk, four; the second from below a little rough and somewhat the largest. Lower arm-plates pentagonal.

Description of a Specimen. — Diameter of disk*, $4^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $1.7^{mm.}$; width of arm without spines, $.7^{mm.}$; length of arm, $35^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1 : .7. Mouth-papillæ, three on each side, in a continuous row; outermost one broader than both the others; two inner ones very small, rounded, bead-like. Mouth-shields longer than broad, shaped like a spear-head, with the point inward; inner lateral sides much longer than outer ones, which are short and re-enteringly curved; length to breadth, .5 : .3; sometimes the mouth-shield is more blunt within. Side mouth-shields proportionately rather large, triangular, not meeting within, sides often a little re-enteringly curved. Under arm-plates broader than long, pentagonal, with an angle turned inward; sides nearly straight, outer corners slightly rounded; nearly, but rarely *quite*, separated by side arm-plates; length to breadth (tenth plate), .3 : .4; first plate rounded, comparatively large; plates at tip of arm shaped much like the basal ones, but more rounded, and inclining to a heart form. Side arm-plates encroaching below pretty equally, from base to end of arm; above, encroaching less. Upper arm-plates regular, broader than long, oval, more curved within than without, and tapering toward each side; length to breadth (eighth plate), .3 : .6. Disk-scales small, even, a little larger near edge

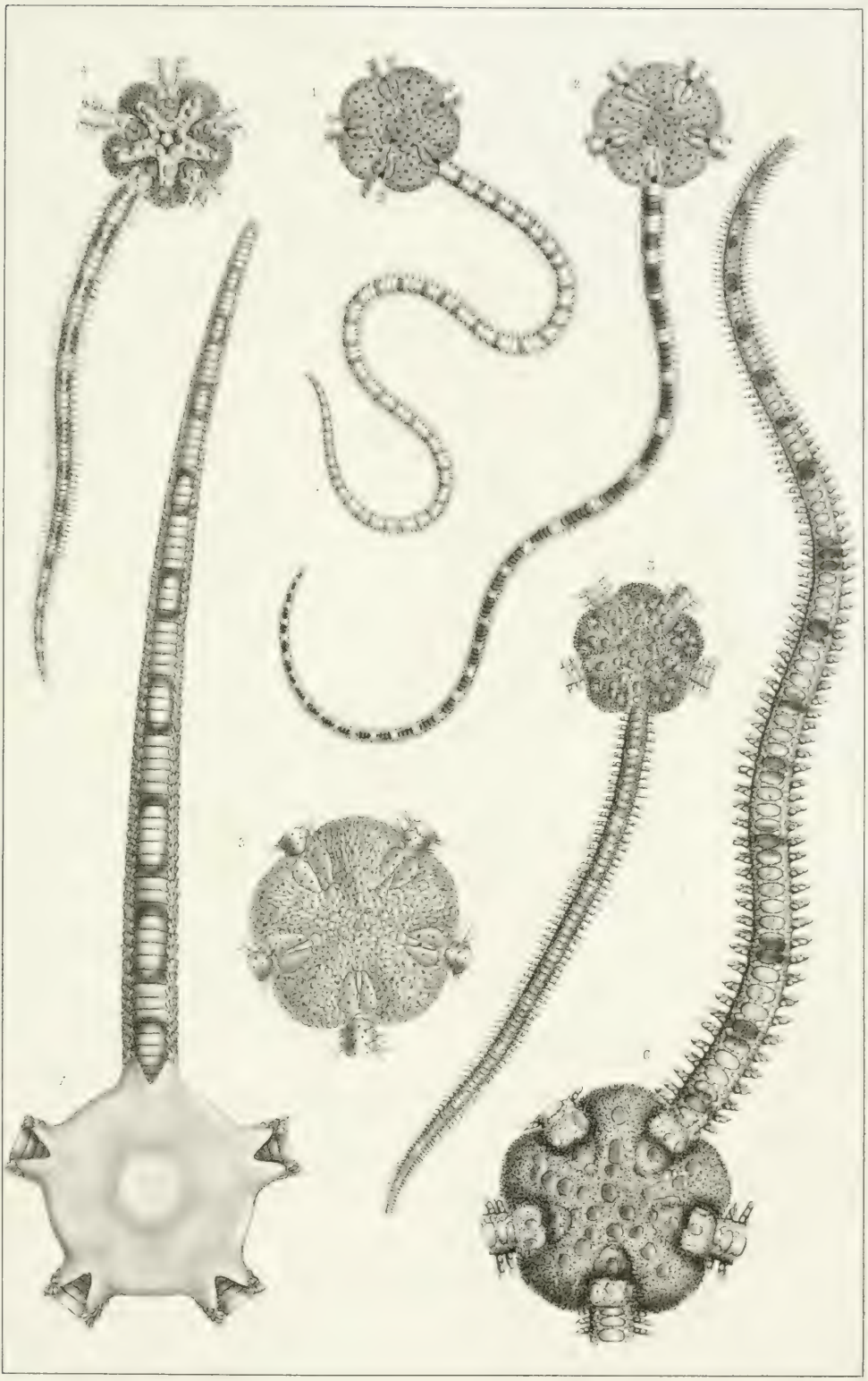
* This measure was taken from one of Dr. LeConte's original specimens, when *dry;* the disk of the living animal probably measured not less than $5^{mm.}$.



Burkhardt & Sonrel

Printed at J.H. Bufford's

1-3 Ophiothrix angulata Ayr — 4. Ophiolepis Garretti Lym'
5. Ophiolepis elegans Ltk' — 6. Ophiomyxa flaccida Ltk.



Burkhardt & Sonrel

Printed at J.H. Bufford's.

1-3. Hemipholis cordifera Lym'. — 4-6. Ophiopholis bellis Lym'
7. Ophiura Holmesii Lym'.

of disk; about 130 to a square *mm.*; those below rather smaller. Radial shields narrow, pointed within, with straight sides; inner ends only separated by a scale, joined for the rest of their length; length to breadth, .7 : .3. Arm-spines four, a little way out only three; short, rounded, tapering but slightly, blunt, stout, with a rounded point; nearly equal, but the two lower ones a trifle longer than the two upper; the middle spine is stoutest and bluntest of all, and a little rough under the microscope; length to that of under arm-plate (fifteenth joint), .4 : .3. Tentacle-scales two, standing at right angles to each other; inside one lying along lateral side of under arm-plate; the free edges of both curved. Color, dry: disk, above, white, arms faded neutral tint; below, much paler.

Variations. — The mouth-shields may be proportionately longer and sharper, or shorter and blunter. The arms above may be irregularly banded with lighter. Dr. LeConte gives the color as "pale gray, arms marked with scattered brown spots."

This species is distinguished from *A. occidentalis* and from *A. atra* by the different forms of the under arm-plates and mouth-shields.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
244	1199	1	Panama.	. . . . .	Dr. J. LeConte.	Dried.
			Smithsonian Institution.			
1199	. .	2	Panama.	. . . . .	Dr. J. LeConte.	Dried.

Amphiura squamata Sars.

Asterias squamata Delle Chiaje. Memorie, III. p. 77. 1828.
Ophiura neglecta Johnston. Mag. Nat. Hist., p. 467. 1835.
Ophiocoma neglecta Forbes. Brit. Starfishes, p. 30. 1841.
Ophiolepis squamata Müll. & Trosch. Syst. Asteriden, p. 92. 1842.
Ophiolepis (*Amphiura*) *squamata* Sars. Middelhav. Lit. Fauna, II. p. 84. 1857.
Ophiolepis tenuis Ayres. Proceed. Boston Soc. Nat. Hist., IV. p. 133. 1852.
Amphiura tenuis Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 194. 1860.

Special Marks. — Arms from two and a half to four and a half times the diameter of the disk. Three regular, tapering, blunt spines; the two lowest equal, the uppermost a little stouter.

Description of a Specimen. — Diameter of disk, 4.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 1.7$^{mm.}$; width of arm without spines, .6$^{mm.}$; length of arm, 19^{mm}; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, .8 : .7. Mouth-papillæ regular, stout; three on each side; outer one longer than inner ones, and about twice as wide; two inner ones of about equal size, nearly square, with corners rounded; the innermost one runs upward to the teeth. Teeth five, flat, thin, squarish; lowest one smallest and most pointed; uppermost one a good deal the largest. Mouth-shields broad heart-shaped, with a sharp point within; rather small; length to breadth, .3 : .4. Side mouth-shields comparatively stout and large, meeting within. Under arm-plates shield-shaped, having an angle within, the outer side nearly straight, and lateral sides a little re-enteringly curved; outer corners rounded; length to breadth (sixth plate), .3 : .3; even the plates at the base of the arm are separated by the side arm-plates; first plate diamond-shaped, very small. Side arm-plates encroaching more below than above. Upper arm-plates rounded; outer side nearly straight; inner and lateral sides included in a common curve; all are slightly separated by the encroachment of the side arm-plates, except one or two at the base of the arm; length to breadth (third plate), .4 : .5. Disk-scales of pretty even size above and below, the latter considerably smaller; above, about 25 to a square *mm.* Radial shields joined for their whole length; shaped somewhat like a slender pear-seed, but with the inside edge straight; their two sharp ends are separated within by a single small scale; length to breadth, .9 : .3. Where the scales of the under surface meet those of the upper, there is a distinct line, made by the upturned edges of the lower scales. Arm-spines three, short, stout, of equal length, a little rounded and flattened, even, tapering, blunt; upper one broadest and stoutest; second, third, and fourth joints, only two spines, which are stouter and more rounded. Tentacle-scales two, rather short and broad, with a strongly curved, free edge; standing to each other at an angle somewhat less than a right angle. Color, in alcohol: nearly white.

Variations. — The disk may be to the arms as 3.6 : 10, or 4.7 : 16.5. The mouth-shields vary in breadth. There are sometimes four arm-spines on one or two basal joints. *A. squamata* has been dredged in from three to six fathoms, and is found creeping over shells and stones. When alive, its color is dark grayish-brown, with radial shields lighter (Ayres). It stands very near to *A. tenera* and *A. pugetana*, but the former has the middle arm-spine thickened at its base, and the latter has arms about twice as long; *A. Puntarenæ* has a notch in the outer side of the lower arm-plate, *A. microdiscus* has differently shaped upper arm-plates, and *A. violacea* has much smaller mouth-shields.

This widely-spread little creature, extending from the Mediterranean on the east, to Massachusetts Bay on the west, possesses a high interest as being *viviparous*, a fact first noticed by Professor De Quatrefages (Comptes Rendus de l'Academie, XV. p. 799, 1842), and afterwards more fully treated by Dr. Schultze (Müller's Archiv., p. 37, 1852). I myself found a good number, during the month of June, in the basin of Arcachon, south of Bordeaux. They lived just below low-water-mark, among bits of broken shell. On being captured, the gravid individuals would often cast off their disk, from which would wriggle out numerous orange-colored young!

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
242	68	1	Oresund.	. . . . .	University Museum, Copenhagen.	Alcoholic.
240	. .	2	Bird Isl., Bost. Harbor.	. . . . .	Prof. Agassiz.	"
241	. .	4	. . . . .	. . . . .	Prof. Agassiz.	"
377 & 378	. .	. .	Nahant, Mass.	. . . . .	. . . . .	"
			Smithsonian Institution.			
1060	. .	2	Massachusetts Bay.	. . . . .	Wm. Stimpson.	Alcoholic.
1047	. .	2	Grand Manan Island.	. . . . .	Wm. Stimpson.	"

Amphiura tenera LÜTKEN.

Amphiura tenera LÜTKEN. Addit. ad Hist. Oph., p. 124.

Special Marks. — Length of arm usually about four times the diameter of the disk. Middle arm-spine swelled at the base.

Description of a Specimen. — Diameter of disk, $3.2^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, $1.3^{mm.}$; width of arm without spines, $.4^{mm.}$; length of arm, $10.5^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, .6 : .6. Mouth-papillæ, three on each side; outermost one wider than both the others together, flat, with a curved, cutting edge; two inner ones separated, nearly equal, small, rounded, bead-like; innermost one of all running upwards to the teeth. Teeth four, longer than broad; two uppermost ones flat, squarish, thin; two lowermost the same, but more rounded, tapering, and pointed. Mouth-shields heart-shaped, with straight sides, and a sharp point turned

inward; length to breadth, .3 : .3. Side mouth-shields proportionately very large, meeting within, shaped like regular wedges, with the broad end out. Under arm-plates a trifle longer than broad, shield-shaped, with an angle within; outer side nearly straight, lateral sides a little re-enteringly curved, outer corners rounded, length to breadth (sixth plate) about .3 : .3. Side arm-plates encroaching above and below, so as to separate both upper and under arm-plates. Upper arm-plates with outer side slightly curved; inner and lateral sides included in a common curve, which has the form of an arch; length to breadth (third plate) about .3 : .4. At the tip of the arm, the joints are much longer than broad, wide without, but greatly constricted within; they are embraced by the side arm-plates, the upper and under plates being small in size, and occupying the outer end of the joint. Disk-scales pretty regular and even; above, about 36 to a square *mm.*; below, considerably smaller; along the margin of the disk, the free edges of the lower scales make a distinct line. Radial shields shaped like elongated pear-seeds, with one side nearly straight; joined for their whole length, except their inner points, which are separated by a single scale; length to breadth, .7 : .2. Arm-spines three (close to disk sometimes an additional one above); uppermost and lowest nearly equal, short, rounded, a little flattened, tapering, rather sharp; lengths to that of under arm-plate, .3 : .3; middle one a trifle shorter, rounded, not flattened, swelled at the base, and contracting suddenly to a point. Close to tip of arm, there are two or three spines, of which the lowest is longest; they are sharper and more elongated than those near base of arm. Tentacle-scales two, of moderate size, standing partly erect, and at an angle to each other. Color, in alcohol: nearly white, with faint traces of brownish on disk.

Variations. — The disk may be to the arms as 3 : 12, 2.7 : 10, or 2 : 6.6. Otherwise the specimens vary scarcely at all. A young one, with a disk of $2^{mm.}$, had the under arm-plates proportionately longer, and the side arm-plates more developed; the disk-scales were in like manner larger, and the primary plates more conspicuous.

A. tenera is distinguished from *A. squamata* and *A. pugetana* by its swollen middle arm-spines; from *A. Örstedii*, *A. violacea*, and *A. microdiscus*, by different upper arm-plates; and from *A. Puntarenæ* by wanting a notch in the lower arm-plates. It has been taken at St. Thomas in four fathoms (A. H. Riise).

LIST OF SPECIMENS.

Catalogue Number.	Original Number	Number of Spec	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
237	67	2	West Indies.	. . . . .	University Museum, Copenhagen.	Alcoholic.
238	. .	2	Charleston, S. C.	. . . . .	Prof. Agassiz.	"
239	1113	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
			Smithsonian Institution.			
1113	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.

Amphiura pugetana Lyman.

Amphiura pugetana Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 193.

Special Marks. — Arms long; often eight times the diameter of the disk; a light line running along their upper side.

Description of a Specimen. — Diameter of disk, 3.5$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 1.5$^{mm.}$; greatest width of arm without spines, .7$^{mm.}$; length of arms, 24.5$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, .6 : .5. Teeth four, stout, flat, rather thick, squarish, with cutting edge curved. Mouth-shields nearly diamond-shaped, the outer and side angles slightly rounded; length to breadth, .3 : .2. Side mouth-shields large, thick, and somewhat swelled; meeting within, closely joined to surrounding parts. Under arm-plates five-sided, with the fifth angle directed inward; length to breadth, near base of arm, .5 : .4. Side arm-plates strong and well developed, meeting above and below. Upper arm-plates bounded within by a strong arch, without by a slight curve; their lateral sides short; length to breadth, near base of arm, .5 : .7; they do not quite touch each other. Scales of disk mostly rounded, smaller below than above; those above of pretty even size, with a few little ones; near edge of disk, about 50 to a square *mm.*; those toward the centre larger. Radial shields closely joined for their whole length, oval, with the inner end pointed; length to breadth, .7 : .3. Arm-spines three, sometimes four on joints close to disk; evenly tapering, moderately stout, of even lengths; length near disk, .5$^{mm.}$. Tentacle-scales two, small and rounded, placed obliquely side by side. Color, in alcohol: disk, above, light

greenish-gray; below lighter, radial shields darker; arms, above and below, straw-color, with a faint white line running lengthwise above.

Variations. — The angles of the mouth-shields may be more or less rounded. Among younger specimens the scales of the disk are more even in size, and the primary plates have their corners not entirely rounded off. The proportion of the arms to the disk varies somewhat; thus: diameter of disk to length of arms as 3.5 : 24.5, 3 : 21, or 2.5 : 22.5.

This species is distinguished from others of the genus as follows: *A. Örstedii* has the radial shields longer, and separated a part of their length; four or five spines and upper arm-plates broader. *A. Puntarenæ* has rather longer arms, a small notch in the outer side of the under arm-plates, and the upper arm-plates regularly oval. *A. violacea* has mouth-shields proportionately much smaller, and the arms shorter; the color must also be quite distinct. *A. microdiscus* has, even in small specimens, the upper arm-plates touching each other, and twice as broad as long. *A. tenera* has the middle arm-spine swelled at the base. *A. squamata* stands very near the present species; but the arms, in specimens of the same size, are not more than half as long.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
231	. .	12+	Mendocino, Cal.	. . . . .	Alex. Agassiz.	Alcoholic.
232	1057	1	Puget Sound.	. . . . .	Dr. Kennerly.	"
380	. .	. .	California.	. . . . .	. . . . .	"
			Smithsonian Institution.			
1053	. .	1	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.
1057	. .	2	Puget Sound.	. . . . .	Dr. Kennerly.	"
1037	. .	1	Puget Sound.	. . . . .	Dr. Kennerly.	"

Amphiura atra Lütken.

Ophiolepis atra Stimpson. Proceed. Boston Soc. Nat. Hist., IV. p. 225. 1852.
Amphiura (*Ophiolepis*) *atra* Lütken. Addit. ad Hist. Oph., p. 118.

Special Marks. — Three arm-spines; under arm-plates narrower without than within, their outer side re-enteringly curved; mouth-papillæ making a connected line; innermost pair running upwards to the teeth.

Description of a Specimen. — Diameter of disk, 9.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.6$^{mm.}$; width of arm without spines, 2$^{mm.}$; length of arm about 95$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.6 : 1.6. Mouth-papillæ wide, somewhat angular, applied end to end, so as to form a connected line; innermost pair extending upwards towards the teeth, and thus partly holding the place of tooth-papillæ; usually six, sometimes eight, to each angle of the mouth. Teeth nine; lowest one small, irregular, often broken in two or three pieces; the rest squarish, flattened, very regular, increasing a little in size towards the upper ones. Mouth-shields small, diamond-shape, longer than broad; length to breadth, 1 : .6; madreporic shield larger and swollen. Side mouth-shields comparatively large, meeting within, broader without than within, and with a slight curve like an *S*. Under arm-plates broader than long, broader within than without; inner and lateral sides nearly straight, outer side re-enteringly curved, corners rounded; length to breadth (seventh plate), .5 : .8; the plates are in contact only at the base of the arm; about the twelfth plate they begin to be separated by the side arm-plates, and begin also to have a slight peak on their inner side, which is the point of juncture of two slightly curved inner laterals; the first plate is quite rudimentary. Side arm-plates rather feeble, long, encroaching above and below, having a very small ridge for spines. Upper arm-plates much broader than long, pointed oval, with outer side nearly straight, and inner sides curved; separated from each other except on the middle line; length to breadth (tenth plate), .6 : 1.7. Disk with closely overlapping scales, about 36 to a square *mm.*; below finer; near radial shields larger; from near the outside corner of the radial shields runs a single straight row of larger scales, passing diagonally over the edge of the disk. Radial shields rather large, irregular oval, with a point within, united without, within separated by a group of scales; length to breadth, 2 : .9. Arm-spines short, round, tapering, sharp; lengths of two lower ones to that of under arm-plate, near base of arm, .9, .9 : .5; upper one somewhat shorter. Tentacle-scales two, broad, short, erect, with a

curved edge, and standing nearly at right angles to each other, the inside one running along the lateral side of the under arm-plate. Color, in alcohol: nearly uniform faded gray.

Variations. — Another specimen of about the same size had the scaling of the disk somewhat finer, and the radial shields almost as wide as long. Mr. Stimpson says that the disk of the living animal is lobulate, and very soft. The creature is of a very dark-gray color, nearly black, except the white madreporic shield; the arms jet black above, except at their extremities. It lives at low water, buried in the mud.

This species is pretty distinct from other *Amphiuræ*, and has some resemblance to *Hemipholis*. It seems to stand nearest to *A. Riisei*, from which, however, it differs in having longer arms, separated under arm-plates, sharper arm-spines, &c.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
246	. .	1	Fort Johnson, Charleston, S. C.	. . . . .	Wm. Stimpson.	Alcoholic.

Amphiura urtica Lyman.

Amphiura urtica Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 195. 1860.

Special Marks. — Some of the disk-scales bearing fine prickles on their edges. Arm-spines sharp, rounded, tapering.

Description of a Specimen. — Diameter of disk, $6^{mm.}$; outer side of mouth-shield to outer corner of opposite mouth-slit, $2^{mm.}$; width of arm without spines, $.8^{mm.}$; length of arms about eleven times diameter of disk (a specimen having a diameter of disk $5.5^{mm.}$, had $55^{mm.}$ length of arm); distance from outer edge of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1 : 1. Mouth-papillæ rounded and bead-like, three on each side. Teeth six, rather irregular, three upper ones largest, stout, longer than broad, thickened; two next smaller and more pointed; lowest one very short and swollen, like a tooth-papilla. Mouth-shields nearly square, with an

angle directed inward; outer angle truncated, and making a slight peak; other angles slightly rounded; length to breadth, .5 : .5. Side mouth-shields not meeting within. Upper arm-plates irregular oval, outer side less curved than inner side; length to breadth, .5 : .7. Under arm-plates scarcely touching each other; inner one five-sided, the rest nearly square, with a strong notch in the outer side; length to breadth, .4 : .4. Scales of disk fine and even, about 140 to a square *mm.*; some of those near margin of disk bearing very fine prickles on their edges. Primary plates not conspicuous. Radial shields elongated oval, tapering within, joined for their whole length; length to breadth, 1 : .5. Arm-spines three, about as long as the joints, delicate, sharp, regularly tapering. Tentacle-scales two, both of them small and delicate. Color, in alcohol: upper and under surface of disk dark greenish-gray, with a margin of light; arms light straw-color.

Variations. — The mouth-shields vary in shape to an unusual degree; sometimes they have a strong peak without, and again none at all; they may be nearly rectangular, or almost oval, and some are not far from round. The under arm-plates may be more or less pentagonal; but, in the adult, most of them are nearly square. The young, with a disk 2.5$^{mm.}$ in diameter, have the under arm-plates pentagonal, with a deep notch in their outer side, and separated by the side arm-plates; they have also, on the back of the disk, a conspicuous rosette of round primary scales.

This species differs from *A. occidentalis* in its notched under arm-plates, sharp spines, and prickly scales of the disk. It is a somewhat aberrant species, and by its prickly scales approaches *Ophiocuida scabriuscula.*

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy			
243	1056	1	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.
			Smithsonian Institution.			
1056	. .	5	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.
1041	. .	6	Puget Sound.	. . . . .	Dr. Kennerly.	"

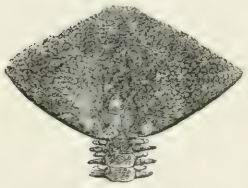
Amphiura occidentalis Lyman. (Figs. 12, 13.)

Amphiura occidentalis Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 194. 1860.

Special Marks. — Mouth-papillæ of nearly equal size. Arm-spines very blunt, and pretty stout. Arms long, flat, broad.

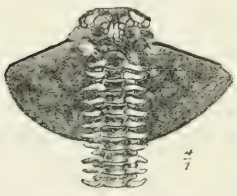
Description of a Specimen. — Diameter of disk, 5.8$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 2.2$^{mm.}$; greatest width of arm without spines, 1.3$^{mm.}$. As the arms were somewhat broken, their length could not well be measured; but, from their proportions, they must have been at least eight times the diameter of the disk. Distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.2 : 1. Mouth-papillæ rounded; innermost one stoutest, and pointing to centre of mouth. Teeth five; four upper ones flat, square, the second from the top largest; lowest one of all smallest, very short, thick, and rounded, somewhat like a tooth-papilla. Mouth-shields small, oval diamond-shaped, the angles being so rounded as to give almost a true oval; outer angle making a very slight peak; length to breadth, .4 : .5. Side mouth-shields not meeting within. Under arm-plates square oblong; angles somewhat rounded; outer side with a slightly re-entering curve; second plate differs from the rest, being five-sided, with its fifth angle directed inward; it is separated from the rudimentary first plate by narrow prolongations of the side arm-plates. The next three or four plates are in like manner separated, while those farther out on the arm are close together, which is an inversion of the usual order. Length of plates to breadth, .4 : .4. Upper arm-plates oblong, with rounded corners; outer side with a slightly re-entering curve; length to breadth, .5 : 1. Scales of disk fine, smooth, and even, above and below; about 60 to a square *mm.*; primary plates distinguished by greater size. Radial shields shaped like an elongated, blunt pear-seed; separated by a narrow, single line of scales; length to breadth, 1.1 : .4. Arm-spines three, not tapering, rather stout, rounded at the end, flattened, about as long as the joints. Two small, rounded tentacle-scales. Color, in alcohol: disk, above, faint greenish-gray; arms and under surface straw-color.

Fig. 12.



Amphiura occidentalis. (Upper side.)

Fig. 13.



Amphiura occidentalis. (Lower side.)

Variations. — The mouth-shields may be quite oval; the second under arm-plate, instead of being five-sided, may resemble the rest.

This species is distinguished from *A. geminata* by the shape of the mouth-shields and of the upper and lower arm-plates, and in having the mouth-papillæ of the same size; from *A. chilensis*, by having two tentacle-scales instead of one.

No. 1063 is from Puget Sound, and may be another species. The spines are blunter, the under scales of the disk larger and less crowded, and the under arm-plates rather more rounded. More specimens will settle the question.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
379	. .	. .	California.	. . . . .	. . . . .	Alcoholic.
229	. .	12+	Mendocino, Cal.	. . . . .	Alex. Agassiz.	"
230	1054	1	Monterey, Cal.	. . . . .	Mr. Sayla.	"
354	. .	1	Gulf of Georgia.	. . . . .	Alex. Agassiz.	"
			Smithsonian Institution.			
1063	. .	1	Puget Sound.	. . . . .	Dr. Kennerly.	Alcoholic.
1054	. .	3	Monterey, Cal.	. . . . .	Mr. Sayla.	"

OPHIOPHRAGMUS* Lyman.

Disk small and delicate, furnished with uncovered radial shields, and covered with naked scales; the scales along the edge of the disk are turned up, so as to make a little fence. Teeth. No tooth-papillæ. Six mouth-papillæ to each angle of the mouth. Arms slender, even, more or less flattened. Arm-spines short and regular, arranged along the sides of the side arm-plates.

* Οφις, snake; φραγμός, hedge.

Ophiophragmus Wurdemanii Lyman.

Amphiura Wurdemanii Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 196.

Special Marks. — Disk-scales smooth, and not regularly arranged. Mouth-shields long and narrow.

Description of a Specimen. — Diameter of disk, 9.5$^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, 3.5$^{mm.}$; width of arm without spines, 2.2$^{mm.}$. Arms remarkably flat, wide, and little tapering; as they were broken, the length could not be known, but it seemed not less than ten times the diameter of the disk. Distance from outer edge of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.6 : 1.5. Mouth-papillæ, three on each side, rounded and bead-like; innermost one placed below the teeth, and running somewhat upward. Teeth broad and flat, with free edge a little curved. Mouth-shields shaped something like the sole of a shoe, very long and narrow, small, with their outer end rounded, and their inner one a rounded point, wider within than without; length to breadth, .8 : .5. Side mouth-shields almost as large as mouth-shields proper, meeting within, somewhat curved. Under arm-plates squarish, rather broader than long, overlapping each other a little; outer side bounded by a slightly re-entering curve, corners rounded; length to breadth (thirteenth plate), .5 : .7. Upper arm-plates very short and broad, overlapping, bounded without by a re-entering curve; outer corners strongly rounded; length to breadth, .4 : 1.7; they are occasionally broken in two. Scales of disk fine, of pretty even size, rather thicker than are usually found in the genus, about 16 to a square *mm.*; those below somewhat finer. Radial shields broad, blunt, pear-seed shaped, sometimes separated by a wedge of three or four scales, sometimes joined by their sides; length to breadth, 2 : 1. Arm-spines three, short, stout, broad, rounded at the end, somewhat flattened, a little longer than joints, nearly alike in shape and size. Tentacle-scales two, short, broad, and thin, with curved edges. Color, in alcohol: above, disk nearly white; arms straw-color, with irregular bands of dark brown; below, arms straw-color, interbrachial spaces white, mouth-shields brown.

This species belongs with those Amphiuræ that have the upper row of the lower scales of the disk strongly developed and standing upright, thus making a sort of fence. It differs from *O. septa** in the shape of the mouth-shields, and in wanting spines on the upper surface of the

* *Amphiura septa* Ltk. and *A. marginata* Ltk. plainly belong in this genus.

disk; from *O. marginata*, in the irregular arrangement of the disk-scales, the different proportions of the arm-plates, &c.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
251	. .	1	Charlotte's Harbor, Florida.	. . . . .	G. Wurdeman.	Alcoholic.

OPHIOCNIDA* Lyman.

Disk small and delicate, furnished with uncovered radial shields; its coat of naked, overlapping scales, is beset with small thorns. Teeth. No tooth-papillæ. Six mouth-papillæ to each angle of the mouth. Arms slender, even, more or less flattened. Arm-spines short and regular, arranged along the sides of the side arm-plates. Two genital slits to each interbrachial space.

SPECIES HEREIN DESCRIBED.

O. hispida. *O. scabriuscula.* *O. neapolitana.*

Ophiocnida hispida Lyman.

Ophiolepis hispida LeConte. Proceed. Phil. Acad., V. p. 318. 1851.
Amphiura (*Ophiolepis*) *hispida* Lütken. Addit. ad Hist. Oph., p. 119.

Special Marks. — Disk gray (in alcohol); arms straw-color, figured with black. Arms to disk as about ten to one. Under arm-plates squarish, but little broader than long.

* Ὄφις, snake; κνίδη, nettle.

Description of a Specimen. — Diameter of disk, 9$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.3$^{mm.}$; width of arm without spines, 1.6$^{mm.}$; length of arm, 95$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.5 : 1.5. Mouth-papillæ, three on each side; two outer ones like short, stout, conical, rounded tubercles; innermost one much the largest; rounded, flattened, swollen; situated higher than the other two, and running upwards to the teeth; resembling a tooth-papilla. Teeth four, lowest one smallest, variable in size, usually broader than long, very thick and rounded, sometimes split in two; second one longer than broad, very stout, nearly cylindrical; third tooth similar, but rather more flattened; uppermost one longest, stout, thick, flattened. Mouth-shields small, short, diamond-shaped, with rounded angles, and sides sometimes straight and sometimes a little curved; length to breadth, .8 : .7. Side mouth-shields small, triangular, somewhat variable, not meeting within. Under arm-plates very regular, squarish, broader than long, with lateral sides nearly straight, outer and inner sides a little curved, and corners rounded; first five or six plates gradually increasing in size, but all of them smaller and proportionately narrower than those beyond; first plate larger than is usual in allied species, corners quite rounded off; length to breadth, .2 : .4; third plate a trifle wider without than within, lateral sides a little re-enteringly curved, inner side nearly straight; length to breadth, .4 : .5; twentieth plate typical; length to breadth, .5 : .7. Side arm-plates encroaching a little above, but not at all below, even at tip of arm. Upper arm-plates much broader than long; outer side nearly straight, with a slight notch in the middle, lateral and inner sides curved, outer corners cleanly rounded; length to breadth (twentieth plate), .5 : 1.3. Disk-scales rather thick for their size, largest near radial shields on the centre of the upper surface, about 70 to a square *mm.*; below, somewhat smaller and more even. The scales are considerably obscured by a pretty thick growth of short, slender, sharp thorns, about .2$^{mm.}$ long; they are everywhere, except on the radial shields, and a bare stripe below, running along each genital slit; the thorns are stouter near the radial shields. Radial shields small, narrow, tapering inward, separated by a strip of thorny scales; length to breadth, 1.8 : .5. Arm-spines three, short, blunt, cylindrical, a little tapering, of nearly equal lengths; lengths to that of under arm-plate (twelfth joint), .6, .6, .6 : .5. Tentacle-scales two, wide, short, thin, with a curved free edge, standing at right angles to each other, the inside one running along the lateral side of the under arm-plate. Color, in alcohol: above, disk dull bluish-gray (clay color); arms straw, with irregular bands and patches of black; below, interbrachial spaces same as upper surface; mouth-parts nearly white; under arm-plates brownish, fading to straw-color farther out on

arm. According to Dr. LeConte, the color of the living animal would seem to be the same.

Variations. — Dr. LeConte's original specimen has the outer side of the upper arm-plates rather more curved, and almost without any notch.

O. hispida differs from *O. scabriuscula* in having narrower under arm-plates, rather longer arms, and longer and sharper spines on the disk; the markings, also, are black, instead of light green.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
251	1052	1	Panama.	. . . . .	Rev. T. Powell.	Alcoholic.
381	. .	. .	Panama.	. . . . .	Dr. Sternberg.	"
			Smithsonian Institution.			
1052	. .	2	Panama.	. . . . .	Rev. T. Powell.	Alcoholic.
1197	. .	1	Panama.	. . . . .	Dr. John LeConte.	Dried.

Ophiocnida scabriuscula Lyman.

Amphiura scabriuscula Lütken. Addit. ad Hist. Oph., p. 118. 1859.

Special Marks. — Arms six to eight times the diameter of the disk. Small and very short spines on the disk. Arm-spines flattened.

Description of a Specimen. — Diameter of disk, 8.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.2$^{mm.}$; width of arm without spines, 1.5$^{mm.}$; length of arm, 52$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.7 : 1.5. Mouth-papillæ, six to each angle of the mouth, small, rounded, separated, slightly flattened, nearly equal, the innermost pair standing a little higher up than the others, and running upwards to the teeth. Teeth four; upper one much the largest, long, flat, moderately thick, with a slightly curved cutting edge; two next smaller, narrower, stouter, more rounded, with the edge thickened at its middle point; lowest one shaped like a broad, rounded, swelled tubercle. Mouth-shields longer than broad, rounded within, prolonged without, in a tail-like projection, inner end terminating in a rounded

point; length to breadth, .9 : .7. Side mouth-shields small, slender, not meeting within. Under arm-plates squarish, separated by a narrow line, broader without than within, inner side slightly curved, outer side nearly straight, lateral sides re-enteringly curved, outer corners projecting; length to breadth (tenth plate), .4 : .6. Upper arm-plates covering whole upper surface of arm, much broader than long, a little overlapping; outer side with a slight re-entering curve in the middle, lateral sides cleanly rounded; length to breadth (twelfth plate), .4 : 1.5. Spines of the disk minute, somewhat larger and more plenty near the edge of the disk, and smaller and fewer towards the centre and in the interbrachial spaces below; the largest are only about .1$^{mm.}$ in length; disk-scales in the centre, and in the interbrachial spaces below, hidden by epidermis; towards the margin they appear rather stout. Radial shields elongated oval, blunt at both ends, touching each other at their outer tips, and then suddenly diverging, the space between them being filled by a group of small scales; length to breadth, 1.6 : .6. Arm-spines three, blunt, rather stout, flattened, hardly tapering, of nearly equal size; lengths to that of under arm-plate (eleventh joint), .6 : .4. Tentacle-scales two, small, but rather thick, standing at right angles to each other, the one lying along the lateral side of the under arm-plate shorter than its neighbor. Color, in alcohol: above, disk, near edges, pale greenish, with a central patch and five radiating lines of yellowish brown (yellow ochre); arms also yellowish-brown, but browner than the tint on the disk; below, coloration the same, without any pale green. Lütken gives the color as pale yellow, with some green bars on the arms.

This species is distinguished from *O. hispida* by shorter arms, and shorter spines on the disk.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
250	58	1	West Indies.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Ophiocnida neapolitana Lyman.

Amphiura neapolitana Sars. Nyt Magazin for Naturvidenskaberne, X. p. 35. 1857.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
416	. .	. .	Alger.	. . . . .	Jardin des Plantes.	Alcoholic.

HEMIPHOLIS Agass. MS.

Disk, above, covered with rounded, rather thick scales, and with large radial shields; below, naked. At the base of each arm, disk slightly indented. Teeth. No tooth-papillæ. Two mouth-papillæ to each angle of the mouth. Side mouth-shields touching each other, so as to form a continuous ring round the mouth. Three short, tapering arm-spines. Two genital slits, beginning outside the mouth-shields.

Hemipholis cordifera Lyman. (Pl. I. Figs. 1–3.)

Asterias cordifera Bosc. Hist. Nat. des Vers, II. p. 113 (1802), II. p. 138 (1830).
Ophiura elongata Say. Journ. Phil. Acad., V. p. 146. 1825.
Ophiolepis elongata Stimpson. Proceed. Boston Soc. Nat. Hist., IV. p. 225.
Ophiolepis uncinata Ayres. Proceed. Boston Soc. Nat. Hist., IV. p. 250.
Hemipholis elongata Agass. MS.
Amphiura elongata Lütken. Addit. ad Hist. Oph., p. 115.
Amphiura cordifera Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 258.

Special Marks. — Arms eight or nine times as long as diameter of disk. One tentacle-scale. Three or four papillæ at base of arms; and a row of fleshy papillæ along genital slits.

Description of a Specimen. — Diameter of disk, 8.3$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3$^{mm.}$; width

of arm without spines, 1.7mm.; length of arm, 81mm.; distance from outer side of mouth-shields to inner points of teeth, to that between outer corners of mouth-slits, 1.6 : 1.8. Mouth-papillæ small, flattened, rounded, situated at the very base of the jaw-frames. Teeth nine, blunt, squarish, much thickened at the middle point of their cutting edge; uppermost one sharp, and much longer than the rest; lowest one projecting less inward than the others. Mouth-shields irregular oval, more strongly curved without; length to breadth, .6 : .9. Side mouth-shields long, narrow, meeting within. Under arm-plates regular, broader than long, with rounded corners, so as to be nearly oval; length to breadth (twenty-fourth plate), .6 : 1. As the side mouth-shields meet on the middle line of the arm, the first under arm-plate is reduced to a little papilla at the outer corner of the mouth-slit. Side arm-plates small, with but a small ridge; encroaching slightly on upper arm-plates. Upper arm-plates much broader than long, outer side nearly straight, and broader than the inner; lateral corners ending in a rounded point; length to breadth (twelfth plate), .6 : 1.5; the first two or three plates are enclosed by the notch in the disk, and are rudimentary. Scales of disk small, rather thick, more or less rounded; among them may be distinguished the primary plates; on the middle line of each interbrachial space is a raised, radiating row of scales, each overlapped by its predecessor, but with its other edges free; on either side of this row the scales are smaller, and overlap each other like those of a fish. Radial shields pear-seed shaped, with the point inward; large; length to breadth, 1.9 : 1.2; set back a little from the margin of the disk, separated by a wedge of three scales, whereof the outer is long and narrow, the inner nearly round, and the middle one intermediate; on each side of the notches in the disk, three or four little, slender papillæ, like small arm-spines. The scaly coat extends over the disk margin, and there ceases abruptly. Under surface covered with a naked, somewhat wrinkled skin; along edges of genital slits a row of small, tapering, fleshy papillæ. Arm-spines equal, rounded, tapering, sharp; lengths to that of under arm-plate, .7, .7, .7 : .6. Tentacle-scale one, small, flat, a little longer than broad, rounded, standing well clear of lower arm-plate. Color, in alcohol: above, ground color greenish gray (sap-green and neutral tint), radial shields and some of the disk-scales much lighter; arms rather darker than disk, growing lighter towards their tips, but banded with dark rings, each including one or two joints; below, interbrachial spaces brownish flesh-color; under arm-plates same color as upper surface, but much paler; arm-spines nearly white.

Variations. — According to Professor Agassiz's colored drawings, the tints vary very much; the ground color of the disk may be dull indigo-blue, various shades of greenish, yellowish brown, yellow, gray, or

brownish flesh-color; the radial shields are usually different from the disk, and may be bright or dull green, dark brown, lake-red, bluish, dull brown, or gray; the arms also commonly differ from the disk, and are commonly banded; one specimen had them sap-green, another lake-red, and a third brownish flesh-color, banded with black. The disk seems never to be uniform, but always speckled or mottled with two or more colors. The tentacles are red. In other respects this species seems to be singularly uniform. The young, when very small, differ extremely from the adult; they are found clinging to the arms and disk of the parent. A specimen with a disk of .5$^{mm.}$, had arms 1.3$^{mm.}$ in length, and with eight joints; the whole upper surface of the disk was occupied by six primary plates, of which the middle one was regularly pentagonal, the other five surrounding it regularly hexagonal; the upper arm-plates were reduced to a small oval plate at the outer end of each joint, while most of the upper surface was occupied by the side arm-plates, which met along the middle line; they met also below, but the under arm-plates were longer than the upper, and had the form of a long, sharp wedge, with the outer side a little curved; the arm ended in a three-lobed papilla, evidently the beginning of a new joint; the arm-spines were only two in number, and the lower one had two or three hooks along its edge; the mouth occupied more of the under surface than in the adult; on each side of the mouth-shields appeared a squarish papilla (side mouth-shields); the jaw, with its three teeth, was prominent, and outside of it were the two mouth-papillæ, already well formed. Another young one, with a disk of 1$^{mm.}$, showed already great advancement; the arms were 7.3$^{mm.}$ long, and had twenty-two joints; the upper arm-plates were large and heart-shaped, with the point inward, resembling much the adult shape of *Amphiura tenera;* the under arm-plates were long, with straight outer and lateral sides, and an angle within; the side arm-plates had become much more restricted; there were three arm-spines, rather blunter than those of the adult; only at the tip of the arm did the lowest spine have hooks; the mouth-parts were nearly as in the grown animal, but with wider mouth-shields; the whole centre of the upper disk surface was still occupied by six primary plates, but, in addition, there was a radiating row of three primary plates in each interbrachial space, and in each brachial space a single additional plate, between which and the base of the arms were the beginnings of two radial shields; all these plates were connected, and made an elegant mosaic; in the grown animal they may be recognized by their greater size, but they are then quite separated by numerous smaller scales. A specimen with a disk of 2.3$^{mm.}$ had the primary plates a good deal rounded; the radial shields were fully formed, and a few of the smaller scales had begun to appear.

This species "is gregarious, living in companies of twenty or thirty.

The existence of these groups is indicated at low water, by spaces of about a foot in diameter, covered with small holes, looking very much as if a charge of shot had been fired into them. If these spots are watched as the tide rises, from each hole an arm of one of the star-fishes will be seen to protrude, and wave about in the water. Generally each individual sends up one of its rays in this manner" (Stimpson).

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
199	. .	12+	Charleston, S. C.	. . . . .	Prof. Agassiz.	Alcoholic.
200	. .	12+	Charleston, S. C.	1852.	Prof. Agassiz.	"
201	. .	12+	Charleston, S. C.	1852.	Prof. Agassiz.	"
202	. .	12+	Charleston, S. C.	1852.	Prof. Agassiz.	"
			Smithsonian Institution.			
1009	. .	12+	South Carolina.	. . . . .	Mr. Cassidy.	Alcoholic.
1201	. .	12+	South Carolina.	. . . . .	Wm. Stimpson.	"

OPHIONEREIS Lütken.

Type of the Genus, *O. reticulata* Lütken.

Disk covered with flat scales, varying little in size, overlapping, rounded. Teeth. Mouth-papillæ. No tooth-papillæ. Smooth spines (commonly three) along the sides of the side arm-plates. One large tentacle-scale. Each upper arm-plate furnished with a supplementary piece on either side. Two genital slits beginning outside the mouth-shields.

SPECIES HEREIN DESCRIBED.

O. reticulata.
O. annulata.
O. Xantusii.
O. porrecta.
O. dubia.

Ophionereis reticulata Lütken.

Ophiura reticulata Say. Journ. Phil. Acad., V. p. 148. 1825.
Ophiolepis nereis Lütken. Vidensk. Meddelelser. March, 1856.
Ophionereis reticulata Lütken. Addit. ad Hist. Oph., p. 110.

Special Marks. — Disk yellowish brown, with a network of five brown lines. Middle arm-spine about twice as long as the under arm-plate.

Description of a Specimen. — Diameter of disk, 11.5$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 4.4$^{mm.}$; greatest width of arm without spines, 2.2$^{mm.}$; length of arm, 90$^{mm.}$; distance from outer edge of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, as 2 : 2.2. Ten mouth-papillæ to each angle of mouth; outermost one small and sharp; the rest short, flat, and stout; the two innermost ones point to centre of mouth, and are shortest and most rounded. Teeth five, flat, square, and thin, the lowest one smallest. Mouth-shields long heart-shaped, point inward, varying somewhat in size; length to breadth, 1.4 : 1.2; madreporic shield broader. Side mouth-shields very long triangular, varying somewhat, connecting first under arm-plate with mouth-shield; length to breadth, .8 : .4. Under arm-plates have general form of squares with rounded corners; first plate very small, narrowest at inner end; length to breadth, .4 : .4; second plate, inner side nearly straight, outer side curved, lateral sides nearly straight; length to breadth, .6 : .8; twelfth plate, outer side a little re-enteringly curved, inner side slightly curved, lateral sides a little re-enteringly curved, outer corners well rounded, inner corners slightly peaked; length to breadth, .8 : 1; this is the typical form; about two thirds out on arm, length to breadth, .8 : .8; at tip of arm, plates long heart-shaped, point inward, longer than broad. Side arm-plates small, being reduced to a ridge, bearing arm-spines; this is very low, so that bases of arm-spines stand almost directly on arm proper. Upper arm-plates have at base of arm the shape of a pointed, distorted oval; first three plates very small, like scales (somewhat as in *Ophiocoma crassispina*), each larger than its successor; fourth plate, inner side slightly curved, outer side short, lateral sides long and sloping; length of plate, .6; outer corners much rounded, so that outer side and lateral sides may be said to form one curve; this is the typical shape; twelfth plate larger; length to breadth, .8 : 1.6; about two thirds out on arm, outer side and laterals not forming one curve, but quite distinct; length to breadth, .6 : 1.2. Here the supplementary plates become much smaller, and finally disappear close to the tip of the arm; and, on the other hand, the true upper plates begin to

approach the hexagonal form; the inner side and inner laterals become distinct from each other, as do the outer side and outer laterals. Close to tip, length to breadth, .4 : .8; at tip of arm, plates heart-shaped, the point inward. Supplementary upper plates fill the space between true upper arm-plates and upper arm-spine; they are nearly triangular, with two angles directed sideways, and one inward; side next upper arm-plate, nearly straight; other two a little curved; length of sides at tenth joint, outer side 1, other two .8. Disk: radial shields small and narrow, blunt at outer end, sharp at inner end, placed just opposite outside line of each arm; length about $1^{mm.}$; breadth, $.4^{mm.}$; starting from each radial shield, and running along edge of disk, is a row of about seven scales, much larger than the rest, largest having a length of $.4^{mm.}$; scales just round and between radial shields somewhat larger than those toward centre of disk, which are very minute, about 230 to a square *mm.*; on under surface of disk, similar scales; starting at mouth-shield, and running along edge of genital slit for about half its length, is a narrow ridge, bearing a single row of small papillæ. Arm-spines: second joint, two; length to that of under arm-plate, .6, .6 : .6; third joint, three spines; fourth joint, three spines, .6, .8, .8 : .6; seventh joint, three spines, .8, 1.2, .8 : .6; all other joints, to very near tip of arm, three spines; twenty-second joint, 1.2, 1.6, 1.4 : .8; about two thirds out on arm, .8, 1, .8 : .8; it is only at extreme tip of arm that there are only two spines. Tentacle-scales near base of arm having a length of $.4^{mm.}$, in form short oval. Color, in alcohol: general tint of upper parts very light grayish-brown (vandyke-brown and a little neutral tint); upper surface of disk irregularly reticulated with lines of light brown; upper surface of arms barred with greenish black; bars usually the width of a joint, seldom more; their dark color not uniform, but concentrated round edges of upper arm-plates; general tint of under surface like that of upper, but lighter; mouth-shields, tentacle-scales, larger arm-spines, and some of under arm-plates, faintly marked with light brown; towards end of arm some faint bars on its under surface; just outside mouth-shield, the interbrachial space is dark umber-brown.

Variations. — A young one, with a disk of $3^{mm.}$, differed from the adult principally as follows: the disk had the primary plates still large and distinct, although they were smaller, and the other scales more numerous than in the young *O. annulata* of the same size; the under arm-plates were longer; the mouth-shields were pointed at their inner end, and the side mouth-shields were so large as nearly, or quite, to meet within. The proportions of the disk to the arms range as follows: 5.1 : 23, 8 : 47, 10 : 60, 11.5 : 90. The colors vary but little.

This species is distinguished from *O. annulata* by having the middle arm-spine shorter; from *O. porrecta*, by longer arm-spines; and from *O. Xantusii*, by sharper arm-spines and longer arms.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
12	. .	12+	Cape Florida.	Apr. 1858.	G. Wurdeman.	Alcoholic.
13	. .	2	Florida.	. . . . .	Prof. Agassiz.	"
14	. .	4	Tortugas, Fla.	Mh.15,17.'58.	J. E. Mills.	"
15	. .	4	Key West, Fla.	Mar. 6, 1858.	J. E. Mills.	"
16	. .	1	Tortugas, Fla.	Feb. 1856.	T. Lyman.	"
17	. .	1	Tortugas, Fla.	Ap. 13, 1858.	J. E. Mills.	"
18	. .	1	Key Biscayne, Fla.	Feb. 1856.	T. Lyman.	"
19	. .	1	Near Cape Florida.	Feb. 1856.	T. Lyman.	"
20	. .	12+	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
21	56[a]	3	Bermudas.	. . . . .	Univ.Mus.Cop'hagen.	"
22	56[bc]	4	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
23	. .	12+	Cape Florida.	. . . . .	G. Wurdeman.	"
24	. .	2	Tortugas, Fla.	. . . . .	Capt.D.P.Woodbury.	"
25	. .	2	Bay of Cumana, South America.	. . . . .	Capt. Couthouy.	"
			Smithsonian Institution.			
1010	. .	8	Cape Florida.	. . . . .	G. Wurdeman.	Alcoholic.
993	. .	1	Tortugas, Fla.	. . . . .	Capt. Woodbury.	"
992	. .	2	Florida.	. . . . .	. . . . .	"
1003	. .	1	St. Thomas, W. I.	. . . . .	University Museum, Copenhagen.	"
1194	. .	1	Florida.	. . . . .	Dr. Cooper.	"
1079	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1114	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1158	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophionereis annulata Lyman.

Ophiolepis annulata LeConte. Proceed. Phil. Acad., V. p. 317. 1851.
Ophiolepis triloba Lütken. Vidensk. Meddelelser. March, 1856.
Ophiolepis triloba Lütken. Addit. ad Hist. Oph., p. 112.
Ophionereis annulata Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 203.

Special Marks. — Disk ash-gray, white, or purplish brown, spotted with light; arms banded. The middle arm-spine about three times as long as the under arm-plate.

Description of a Specimen. — Diameter of disk, 11.5[mm.]; from outer side of mouth-shield to outer corner of opposite mouth-slit, 5[mm.]; width of arm without spines, 2.2[mm.]; length of arms, 84[mm.]; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2 : 2.5. Mouth-papillæ nine or ten, small, rounded, blunt, except outer one, which is minute and sharp-

pointed; the one next to the outer is the largest of all. Teeth five, squarish, a little swelled at the cutting edge; lowest one much shorter than the rest, and somewhat thickened. Mouth-shields nearly rounded, with a slight peak outwards; length to breadth, 1.4 : 1.4. Side mouth-shields rather larger than usual in this genus; triangular, rounded without, pointed within. Under arm-plates squarish, outer side with a notch, inner side curved, lateral sides re-enteringly curved, outer corners cleanly rounded; length to breadth (twenty-second plate), .7 : 1.1. Upper arm-plates wider within than without; outer side either forming a single curve, or broken into three sides, an outer and two lateral; inner side broken into three parts, an inner and two inner laterals, all of them lying almost in the same line; length to breadth (twenty-ninth plate), .7 : 1.7. Supplementary pieces as long as the joints, triangular, with the outer side somewhat rounded. Disk-scales very fine above and below; coarser along edge of disk; where they are finest, about 170 to a square *mm.* Radial shields small, narrow, sharp at both ends; length, .8$^{mm.}$. Arm-spines rounded, tapering, a little flattened, regular; middle one longest; lengths to that of under arm-plate (twenty-fourth joint), 1.2, 2.2, 1.6 : .7. Tentacle-scale large, rounded oval; length to that of under arm-plate, .5 : .7. Color, in alcohol: above, disk dull ash-gray (burnt umber and neutral tint), ground color of arms pale yellowish-gray, with broad bands of dark ash-gray; even the lighter rings have usually markings of darker; three joints of light usually alternate with three of dark; below, interbrachial spaces veined with fine brown lines; a patch of nearly black just outside the mouth-shields; rest of under surface nearly white, with a few under arm-plates brown.

Variations.—The commonest pattern of color seems to be a purplish-brown disk, with numerous light spots, and light-greenish arms, with rings of purplish brown; sometimes the disk is white. A young one, with a disk of 3$^{mm.}$, had arms 15.5$^{mm.}$ in length. The upper surface of the disk was chiefly occupied by the large primary plates, of which there was a rosette of six in the centre, and these did not overlap each other; other primary plates were arranged about them, and between these were a few small, overlapping scales. The radial shields were separated by three scales, and were larger proportionately than in the adult. The upper arm-plates were nearly circular, the supplementary pieces comparatively small. Below, the parts were pretty much as in the adult, except that the under arm-plates were proportionately longer, and the side mouth-shields and interbrachial spaces larger.

This species has longer arms and sharper spines than *O. Xantusii;* and the middle arm-spine is longer than in *O. reticulata,* or in *O. porrecta.* The following table will show their proportions: —

	Disk.	Arms.	Lower Arm-plate.	Middle Arm-spine.
O. reticulata,	10.5	70	.7	1.6
O. Xantusii,	7.7	40	.5	1.2
O. porrecta,	12.0	113	1.0	1.7
O. annulata,	11.5	84	.7	2.2

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
28	. .	8	Panama.	. . . . .	Alex. Agassiz.	Alcoholic.
29	57	1	West Coast of Central America.	. . . . .	University Museum, Copenhagen.	"
30	. .	8	Panama.	. . . . .	Dr. J. LeConte.	Dried.
			Smithsonian Institution.			
1038	. .	1	Panama.	. . . . .	Rev. T. Powell.	Alcoholic.
1096	. .	1	Panama.	. . . . .	. . . . .	"
1097	. .	1	Panama.	. . . . .	. . . . .	"
1200	. .	5	Panama.	. . . . .	Dr. J. LeConte.	Dried.
1191	. .	1	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.

Ophionereis Xantusii Lyman.

Ophionereis Xantusii Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 258. 1860.

Special Marks. — Brownish straw-color, arms banded with dark purple. Arms about five times as long as the diameter of the disk.

Description of a Specimen. — Diameter of disk, 7.7$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3$^{mm.}$; width of arm without spines, 1.2$^{mm.}$; length of arm, 40^{mm}; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 1.2 : 1.5. Mouth-papillæ, ten or eleven to each angle of mouth, small, rounded, somewhat flattened. Teeth four, thin, flat, squarish; lowest one thicker, and with a rounded cutting edge. Mouth-shields much rounded heart-shaped, with narrow end inward; length to breadth, 1 : .9. Side mouth-shields short triangular, widely separated within. Under arm-plates squarish, a little longer than broad; outer side slightly curved; lateral sides a little re-enteringly curved; inner laterals and inner side of about the same length, and lying nearly in the same line; length to breadth (seventeenth

plate), .5 : .4. Upper arm-plates triangular, with a rounded angle directed outward, and a sharp angle directed towards each side; length to breadth (eleventh plate), .5 : .9. Supplementary pieces as long as the joints, triangular, with outer side curved; near the end of the arm they become proportionately smaller, and the upper arm-plates gradually take on a more hexagonal shape. Disk-scales very close and fine, about 200 to a square *mm.* Radial shields very small and narrow, about .7$^{mm.}$ long. The usual comb of papillæ along the edges of the genital slits is not much developed. Arm-spines rather short, flattened, and cut off square at the end; middle one longest; lengths to that of under arm-plate (seventeenth joint), .7, 1.2, .9 : .5. Tentacle-scale large, round, thin; length to that of under arm-plate, .3 : .5. Color, in alcohol: above, disk faint greenish-gray, finely lined with brownish; above the base of each arm a dark-purple fork, of two converging lines; sometimes a few other veins of dark purple; arms brownish straw-color, with a faint, broken line of whitish running lengthwise; at intervals of from five to twelve joints, a dark purple joint, making a cross band; below, interbrachial spaces same as upper surface; other parts light straw-color.

Variations. — The color seems pretty uniform; the dark markings at the base of the arms may differ somewhat in shape and size, and the arm bands may either go entirely round, or be confined to the upper surface. A small specimen, with a disk of 4.2$^{mm.}$, had arms of 22$^{mm.}$. The number of disk-scales to a square *mm.* was about the same as in larger ones. The lower arm-plates were longer, and more concave on their lateral sides; the teeth had all round cutting edges; the spines were more rounded and tapering than in the adult; length of the longest to that of under arm-plate, .5 : .3; the radial shields could hardly be distinguished. The mouth-shields vary a little in being more or less rounded.

O. Xantusii differs from *O. annulata* in having shorter and blunter arm-spines, and shorter arms; the color is also different; — from *O. reticulata*, in blunter arm-spines, shorter arms, and a different pattern of color.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
31	1164	1	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.
			Smithsonian Institution.			
1164	. .	5	Cape St. Lucas, Cal.	. . . . .	J. Xantus.	Alcoholic.

Ophionereis porrecta Lyman. (Figs. 14, 15.)

Ophionereis porrecta Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 260. 1860.

Special Marks. — Dull reddish-brown. Arms, in adult specimens, nine times as long as the diameter of the disk. Arm-spines short.

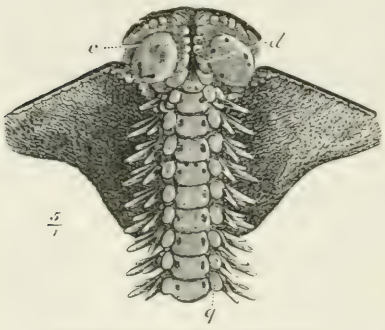
Description of a Specimen. — Diameter of disk, 12$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 4.5$^{mm.}$; width of arm without spines, 2.5$^{mm.}$; length of arm, 113$^{mm.}$; distance from outer side of mouth-shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 2 : 2.2. Mouth-papillæ ten, short, stout, the outermost but one broadest. Teeth four or five, stout, squarish, rather long, a little tapering, lowest one shortest. Mouth-shields oval; length to breadth, 1.6 : 1. Side mouth-shields very small, triangular, sometimes almost obliterated. Under arm-plates squarish, broader without than within; outer side curved, inner side nearly straight, lateral sides re-enteringly curved; length to breadth (twentieth plate), 1 : 1.2; (fortieth plate), 1 : 1.4. The first plate is wedge-shaped, with a curved outer side. Upper arm-plates varying in proportionate breadth according to the width of the arm, usually broader than long; inner side much longer than outer one; outer and lateral sides sometimes distinguished, and sometimes confounded in a common curve; length to breadth (sixth plate), .8 : 1.5; (thirty-fifth plate), 1 : 1.6. Scales of disk rather stouter than usual in the genus; about 80 to a square *mm.* Radial shields 1.2$^{mm.}$ long. Scales on edge of disk larger than the rest. Papillæ along edges of genital slits stout and prominent. Arm-spines short, rounded, tapering; lengths to that of under arm-plate (twenty-

Fig. 14.

Ophionereis porrecta. (Upper side.) *p*, arm-spines

third joint), 1, 1.7, 1.3 : 1. Tentacle-scale oval, large ; length to that of under arm-plate, .6 : 1. Color, in alcohol: above, disk minutely mottled and lined with reddish brown (vandyke brown and red chalk) and dirty white ; arms the same, but darker, with occasionally a light-colored joint ; arm-spines pale brown, with one or two darker rings ; underneath interbrachial spaces tawny brown ; darker along the genital slits ; mouth-parts and under arm-plates white ; the arm-plates and mouth-shields with a few specks of various tints of brown.

Fig. 15.



Ophionereis porrecta. (Lower side.)
d, mouth-papillæ ; *c*, inner point of mouth angle ; *q*, tentacle-scale.

Variations. — A young one, with a disk 3$^{mm.}$ in diameter, had arms 18$^{mm.}$ long. The disk-scales were large, about 40 to a square *mm.*, and among them could plainly be recognized the primary plates ; the radial shields were conspicuous, though small, and were separated by a wedge of two or three scales ; the upper arm-plates were very nearly circular, and overlapped each other ; the lower arm-plates were shield-shaped, with an angle within, and a wide, straight outer side, and were entirely separated by the encroachment of the side arm-plates. The other parts were as in the adult, except that the side mouth-shields were proportionately larger. In a specimen with a disk of 5$^{mm.}$, the upper arm-plates were shaped nearly as in the adult ; the under arm-plates were tawny red. Among the young the radial shields were commonly bordered with dark brown, with a white centre. The other colors varied chiefly in intensity.

The locality of these specimens has unfortunately been lost ; but they are believed to be from the Atlantic coast of America, and are therefore included here. The species is distinguished from others by the great length of the arms, the shortness of the arm-spines, and the general robustness of the structure.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
11	..	7	Florida ?	.....	.....	Alcoholic.

Ophionereis dubia Lyman.

Ophiolepis dubia Müll. & Trosch. Syst. Asteriden, p. 94.
Savigny. Descr. de l'Égypte (Audouin). 1809. Pl. 1, Figs. 3^1-3^{10}.

The plate of Savigny is most excellent, and gives all the details of the genus and species. The specimen doubtless came from the Red Sea, as the species is not found in the Mediterranean.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
434	. .	. .	Red Sea.	. . . . .	Jardin des Plantes.	Alcoholic.

OPHIOPSILA Forbes.

Type of the Genus, *O. aranea.*

Disk covered with very minute, overlapping, smooth scales. Radial shields small, or else quite covered. Teeth. Tooth-papillæ. A few side mouth-papillæ. Arm-spines short, flattened, rather rough, numerous, arranged along sides of side arm-plates. Inside tentacle-scale very long, like a spatula. Lower arm-plates faintly indicated and sunken, making a groove in which lie the long tentacle-scales. Two genital slits beginning outside the mouth-shields.

SPECIES HEREIN DESCRIBED.

O. Riisei.
O. aranea.

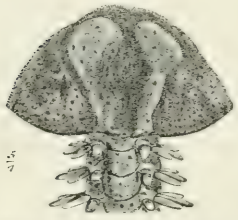
Ophiopsila Riisei Lütken. (Figs. 16, 17.)

Ophiopsila Riisei Lütken. Addit. ad Hist. Oph., p. 136. 1859.

Special Marks. — Arm-spines, six or seven. In the adult, many of the upper arm-plates split in two. Color, in alcohol: gray, with fine black specks.

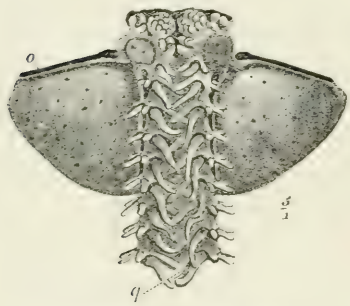
Description of a Specimen. — Diameter of disk, 8.6$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3$^{mm.}$; width of arm without spines, 2$^{mm.}$. For length of arm, see *Variations*. Distance from outer side of mouth-shields to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 1.6 : 1.6. Mouth-papillæ, six to each corner of the mouth, of which the outer one is a minute tubercle, scarcely perceptible; the two inner ones on either side large, flat, and square. Tooth-papillæ in an irregular bunch, about nine in number; lowest ones smallest, and placed more outward. Teeth five, four upper ones broad, short, thick, even, squarish; lowest one narrower, and more like a large tooth-papilla. Mouth-shields broader than long, oval diamond-shaped, with a peak within; the outer side curved, and the lateral ends more or less truncated; length to breadth, .7 : 1. Side mouth-shields scarcely to be seen, even in dried specimens. They seem to run along the inner side of the mouth-shield, but are extremely narrow, and are often quite confounded with the surrounding parts. Under arm-plates broader than long, slightly separated, nearly rectangular, but a little wider without than within; length to breadth (fifteenth plate), .5 : .7. Upper arm-plates broader than long, nearly oval, somewhat angular, however, at the corners; many of them broken lengthwise in two pieces; the first six or eight plates are proportionately smaller, narrower, and more rounded than those just beyond; length to breadth (third plate), .5 : .7; (twenty-third plate), .6 : 1. Disk-scales covered with a thick skin, so that they are not easy to see, even in a dried specimen; about 150 to a square *mm.* where they are finest; over the places of the radial shields, somewhat coarser. Arm-spines usually six, near the disk seven; cut square off at

Fig. 16.



Ophiopsila Riisei. (Upper side.)

Fig. 17.



Ophiopsila Riisei. (Lower side.)
q, tentacle-scale; *o*, genital opening.

the end; lengths to that of under arm-plate (thirteenth joint), .5, .4, .4, .4, .5, .8:.5. Outside tentacle-scale minute, flattened, spiniform; length of inside scale to that of under arm-plate, 1 : .5. Color, in alcohol: nearly uniform pale brownish-gray, with numerous specks of black pigment on the back and interbrachial spaces of the disk, and on the upper arm-plates; mouth-parts nearly white, with a black speck on each mouth-shield.

Variations. — The coloration in alcoholic specimens is nearly uniform, and the other characters vary little. A specimen with a disk of $8^{mm.}$, had arms $100^{mm.}$ long. This may be considered an average proportion. Almost always the tips of the arms are broken off. The largest specimens have a disk of over $11^{mm.}$

O. Riisei has been found at St. Thomas by Mr. Riise, but is apparently not very common there; and the same remark is true of the Tortugas Islands, of Key West, and of some other parts of Florida; but at Cape Florida it has been taken in the greatest abundance.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
1	. .	12+	Cape Florida.	Apr. 1858.	G. Wurdeman.	Alcoholic.
2	. .	1	Florida?	. . . . .	Prof. Agassiz.	"
3	. .	2	Key West, Fla.	Jan. 1858.	J. E. Mills.	"
4	. .	1	Florida.	. . . . .	Prof. Agassiz.	"
5	. .	2	Cape Florida.	. . . . .	G. Wurdeman.	"
6	. .	1	Florida.	. . . . .	Prof. Agassiz.	"
			Smithsonian Institution.			
995	. .	12+	Cape Florida.	. . . . .	G. Wurdeman.	Alcoholic.
1177	. .	1	Florida.	. . . . .	. . . . .	"

Ophiopsila aranea Forbes.

Ophiopsila aranea Forbes. Trans. Linn. Soc., XIX. p. 149.
Ophianoplus marmoreus? Sars. Nyt. Mag. for Naturvid., X. p. 23.
Ophiopsila marmorea Lütken. Addit. ad Hist. Oph., p. 136.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
424	. .	. .	Alger.	. . . . .	Jardin des Plantes.	Alcoholic.

OPHIOCNEMIS Müll. & Trosch.

Müller and Troschel made a most singular mistake in examining the original specimen of Lamarck's *Ophiura marmorata*, on which is founded this genus. The specimen having shrunk in drying, a small crack appeared between the arm-joints and the genital plate, and this was taken for a *second genital slit*, lying beside the usual one. I had an opportunity of closely examining this specimen in the Jardin des Plantes. Nevertheless the genus is a good one, on other grounds, and stands between *Amphiura* and *Ophiothrix*.

Ophiocnemis marmorata Müll. & Trosch.

Ophiura marmorata Lamarck. An. s. Vert., II. p. 543.
Ophiocnemis marmorata Müll. & Trosch. Syst. Asterid., p. 87.

The original, in the Jardin des Plantes, is stated to come from the "Mers Australes," and was brought by Peron and Lesueur, in 1803.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
409	. .	12+	Zanzibar.	. . . . .	C. Cooke.	Alcoholic.
410	. .	12+	Zanzibar.	. . . . .	C. Cooke.	"
428, young?	. .	. .	Trincomalee, Ceylon.	. . . . .	Jardin des Plantes, Reynaud, 1829.	"

OPHIOTHRIX Müll. & Trosch.

Type of the Genus, *O. rosula* Forbes.

Disk with thorny grains, very short spines crowned with thorns, or spines with thorns at the sides and top. Radial shields large, triangular swellings, each bounded on its two inner sides by ridges in the skin of the back. Tooth-papillæ. Teeth. No mouth-papillæ. Spines numerous (often three times as long as the joints), flattened, glassy, thorny, having a central tube with slender side tubes from it. A small, spine-like tentacle-scale. No radial scales. The base of the jaw pierced with a hole, from a want of perfect union between the two pieces of the mouth-frames. Interbrachial spaces swelled out like lobes. Two genital slits beginning outside the mouth-shields. Outer arm-joints with hooks.

GROUPING OF SPECIES HEREIN DESCRIBED.

Disk closely beset with stout, longer and shorter spines,	*O. rosula.*
Disk with long, slender spines,	*O. Örstedii.* *O. Suensonii.* *O. magnifica.* *O. virgata.*
Disk usually beset with short, forked, and with long, slender spines,	*O. angulata.* *O. violacea.* *O. spiculata.* *O. dumosa.*
Disk with fine, thorny grains; upper arm-plates regularly hexagonal,	*O. lineata.*
Disk and radial shields closely beset with spiny cylinders; thorny grains on upper arm-plates,	*O. demessa.*
Disk scaled, and sparsely beset with thorny grains,	*O. propinqua.*
Disk beset with thorny stumps; radial shields closely covered with grains,	*O. Cheneyi.*
Disk and radial shields as in the last; upper arm-plates regularly angular; arms very long,	*O. longipeda.*

Ophiothrix rosula Forbes.

Stella scolopendroides; *Rosula scolopendroides* Linck. De Stel. Mar., p. 52, Pl. XXVI. Fig. 42. 1733.
Asterias fragilis O. F. Müller. Zoöl. Dan., p. 28, Pl. XCVIII. 1789.
Ophiura fragilis et *O. tricolor* Lamk. Hist. Anim. s. Vert., II. p. 546. 1816.
Ophiocoma rosula Forbes. Brit. Starfishes, p. 60. 1841.
Ophiothrix rosula Forbes. Linn. Trans., XIX. p. 151. 1842.
Ophiothrix fragilis, *O. echinata*, *O. tricolor*, et *O. Férussacii* Müll. & Trosch. Syst. Asteriden, pp. 110–112. 1842.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
142	. .	1	North Europe.	. . . . .	Prof. Sars, 1852.	Alcoholic.
143	46	2	Oresund.	. . . . .	University Museum, Copenhagen.	"
417	. .	. .	St. Va-est-la-Hougue, France.	. . . . .	Jardin des Plantes.	"
392	. .	. .	Cette, France.	. . . . .	T. Lyman.	"
418	. .	. .	Oran, Algeria.	. . . . .	Jardin des Plantes.	"

Ophiothrix Örstedii Lütken.

Ophiothrix Örstedii Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiothrix Örstedii Lütken. Addit. ad Hist. Oph., p. 149.

Special Marks. — Bluish or greenish, with cross lines of white on arms, above. Spines on disk slender and rather long.

Description of a Specimen. — Diameter of disk, 8$^{mm.}$; outer edge of mouth-shield to outer corner of opposite mouth-slit, 3.6$^{mm.}$; width of arm without spines, 2.7$^{mm.}$; length of arm about 58$^{mm.}$; distance from outer edge of mouth-shield to the points of the tooth-papillæ, to that between the corners of the mouth-slits as 1.6 : 1.6. Tooth-papillæ arranged in six horizontal rows, three in each row, except the lowest one, which has usually only two; they have the appearance of a bundle of small spines, soldered compactly side by side; the papillæ on the sides of each row project towards the centre of the mouth more than the middle one does. Teeth five, the highest small and somewhat pointed; lowest evidently made of soldered tooth-papillæ. The mouth-shields are closely soldered with the surrounding parts, so that it is

hard to distinguish their true outlines; they are nearly oval, with a slight peak towards the mouth; length to breadth as .6 : 1 or .8 : 1. Madreporic mouth-shield longer, larger, and more swelled than the others; length to breadth as 1 : 1. Side mouth-shields soldered closely with surrounding parts, slender and wedge-shaped, their broadest end being toward the arm; they run along the inner sides of the mouth-shield, and nearly meet at its inner points; length to breadth, .6 : .4, or .8 : .4; as the madreporic mouth-shield extends inwards, the side mouth-shields are here reduced to small triangular pieces on each side. General form of under arm-plates square, but broader than long; the first, second, third, and fourth somewhat compressed sideways, and varying a little in their proportions; the rest of the plates, even near the tip of the arm, nearly uniform in shape, each separated a little from its neighbors, the outer side a slightly re-entering curve, the lateral sides curved a little, the inner side not well defined, but nearly straight; length to breadth (ninth), .7 : 1; about two thirds the length of arm, .6 : .6. Upper arm-plates covered, like those on the sides, with skin; their outlines can only be seen in dried specimens; there are four sides, of which the outer is curved, the two lateral straight, and the inner straight, but so short that the plate looks like a short wedge, with the point towards the disk; the first three or four plates vary in size, but are all small, the innermost often so small that the side arm-plates nearly or quite meet above; the plates beyond larger; length to breadth as follows: second plate, .6 : .8, or .4 : .6; seventh, .8 : .8; inner side of seventh plate, .4$^{mm.}$; the outer edge of each is slightly higher than the next plate, but does not overlap it. Disk, above, the large radial shields are nearly or quite naked; the rest of the back takes the form of a ten-rayed star, with a small centre; the brachial rays are narrow, and separate each radial shield from its mate; the interbrachial rays are wider, and separate the pairs of radial shields; both are beset with spines; the measures are as follows: diameter of centre of star, 2.4$^{mm.}$; length of brachial ray, 3$^{mm.}$; breadth of same, .4$^{mm.}$; breadth of interbrachial ray close to centre, 1$^{mm.}$, or 1.2$^{mm.}$; width of radial shield at outer edge, 1.4$^{mm.}$ to 1.8$^{mm.}$; length of the same, 2$^{mm.}$ to 2.2$^{mm.}$; the brachial rays are of even width till near the base of the arm, where they contract; each bears a single row of about five long, tapering spines; the interbrachial rays are of even width till near the edge of the disk, where they grow wider, and pass over the edge to the under surface of the disk; the spines long and tapering, irregularly placed in three longitudinal rows, each of seven or eight; radial shields quite smooth, sometimes with a single spine. The spines of the brachial rays have a length of 1.2$^{mm.}$ to 1.6$^{mm.}$; those of the interbrachial rays, 1$^{mm.}$ to 1.2$^{mm.}$. The second joint bears only two small, nearly equal, slender spines, having a length to that of the under arm-plate as .8 : .8. Third

joint, four small, slender spines, whose length to that of the lower arm-plate is as .8 : .8 ; fourth joint, five spines, 1, 1, 1, 1, .8 : .8 ; fifth joint, five spines, the upper ones much the longest ; sixth joint, nine spines, four upper ones, 2.8, 2.6, 2.2, 1 : .8. Arm-spines of the seventh joint have a length, compared with that of the under arm-plate, as follows : (beginning above), 2.8, 2.8, 2.8, 2.8, 2.2, 1.6, 1, .8, .6 : .8 ; there may also be a short supplementary spine on one side above the upper long one. Seventh joint may also have only eight spines ; eighth, eight spines, four long, four short ; ninth, seven spines, two long, two middling, three short ; tenth, eight spines, viz., 2, 2.8, 2.8, 1.6, 1.2, .8, .6, .4 : .8 ; eleventh, seven spines, three long, four short ; fifteenth joint, 2.4, 3.8, 3.8, 1.6, 1.2, .8, .5 : .8. In the neighborhood of the twenty-fifth joint, the spines are only six, and have a length to that of the lower arm-plate as follows : 3.6, 3.6, 1.2, 1, .6, .4 : .8. The longer spines, near the base of the arm, have on either edge from four to nine sharp thorns. The spines on the disk are rather less flattened and more slender, and have one or two thorns on each edge. The spinous rays of the back of the disk in an alcoholic specimen are dark cobalt blue, with a greenish hue ; radial shields the same, but lighter ; tooth-papillæ white ; mouth-shields, side mouth-shields, under arm-plates, and side arm-plates, very light cobalt blue, with a greenish tinge, irregularly edged and speckled with white. Upper arm-plates bluish green mottled with white ; between the joints a triple line, consisting of a dark line, with an irregular white one on each side. Arm-spines transparent greenish-blue, with purplish ends. Interbrachial spaces underneath similar to upper surface.

Variations. — The color in alcohol is about the same as that of the living animal ; it is either bluish or greenish. The young show the oblong scales of the disk very distinctly.

The white cross lines on the arms easily distinguish this species from *O. magnifica*, which, moreover, is larger, and has much stouter spines. It is the most abundant species of Florida and the West Indies.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
116	. .	5	Tortugas, Fla.	Feb. 1856.	T. Lyman.	Alcoholic.
117	. .	7	Key Biscayne, Cape Florida.	Feb. 1856.	T. Lyman.	"
118	. .	12+	Florida.	. . . . .	Prof. Agassiz.	"
119	. .	12+	Cape Florida.	. . . . .	G. Wurdeman and J. E. Mills.	"
120	. .	12+	Key West, Fla.	Feb. 1856.	T. Lyman.	"
121	. .	9	Key West, Fla.	Jan. 28, 1858.	J. E. Mills.	"
122	. .	5	Tortugas, Fla.	Mh. 10, 1858.	J. E. Mills.	"
123	. .	12+	Tortugas, Fla.	Feb. 1856.	T. Lyman.	"
124	. .	12+	Key West, Fla.	Mh. 6, 1858.	J. E. Mills.	"
125	. .	12+	Tortugas, Fla.	Apr. 24, '58.	J. E. Mills.	"
126	. .	12+	Florida.	. . . . .	G. Wurdeman.	"
127	. .	12+	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
128	. .	3	Bay of Cumana.	. . . . .	Capt. Couthouy.	"
129	. .	12+	Cape Florida.	Apr. 1858.	G. Wurdeman and J. E. Mills.	"
130	65[ab]	6	West Indies.	. . . . .	University Museum, Copenhagen.	"
131	. .	1	Florida.	. . . . .	Prof. Agassiz.	Dried.
			Smithsonian Institution.			
1014	. .	12+	Tortugas, Fla.	. . . . .	Capt. Woodbury and Dr. Whitehurst.	Alcoholic.
1005	. .	12+	Garden Key, Tortugas.	. . . . .	. . . . .	"
1006	. .	12+	Cape Florida.	May, 1858.	G. Wurdeman.	"
1012	. .	12+	Florida.	. . . . .	. . . . .	"
1160	. .	7	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1090	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiothrix Suensonii Lütken.

Ophiothrix Suensonii Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiothrix Suensonii Lütken. Addit. ad Hist. Oph., p. 148.

Special Marks. — Arm-plates as long as broad. Only about five arm-spines; upper one very long and slender. Color reddish, with a stripe of dark purple along arms.

Description of a Specimen. — Diameter of disk, 7.5[mm.]; from outer side of mouth-shield to outer corner of opposite mouth-slit, 3.5[mm.]; width of arm without spines, 1.5[mm.]; length of arm, 68[mm.]; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 1.7 : 1.7. Tooth-papillæ, eighteen, arranged in an oval figure, those outside longest, those in middle shorter; each outside row has six. Teeth four, upper one long-

est; rather thick, with rounded cutting edge. Mouth-shields very wide, short heart-shaped, with outer side straight, and a little peak within; length to breadth, .5 : 1. Side mouth-shields short triangular, with corners rounded, meeting within. Under arm-plates as long as broad, outer side longer than inner, corners rounded, a re-entering curve on lateral sides, where tentacle-scale comes; length to breadth (eighth plate), .7 : .7. Side arm-plates strongly developed, and bearing stout projections to carry the arm-spines. Upper arm-plates about as long as broad; outer side strongly curved; inner side straight, and much shorter than outer; laterals straight and sloping; length to breadth (seventh plate), .7 : .7. Disk with naked radial shields; brachial rays very narrow; on them and on the interbrachial rays and centre are scattered spines, long, thin, flattened, usually ending in a rather sharp point, about 2.2$^{mm.}$ in length, with about eight thorns on each edge. Radial shields presenting without an acute angle, terminating in a rounded peak; length to breadth, 2.5 : 1.4. Interbrachial spaces below with a few spines of same character as those above, but much shorter. Arm-spines five, sometimes six, upper one commonly much the longest; slender, sharp, somewhat flattened, with about nine thorns on each edge; ninth joint, five spines; lengths to that of under arm-plate, 4.5, 3.5, 2.8, 1.3, .2 : .7; the minute lowest spine becomes a hook very near base of arm. The spines near the end of the arm are extremely long and slender. Tentacle-scales flat, rounded at point, of about same size as lowest arm-spine. Color, in alcohol: above, disk pale purplish, with outer ends of radial shields yellowish; along outer side of radial shields a narrow, raised edge of white; a broad band of very dark purple running along each arm, continued along brachial rays, and ending at centre of disk; side arm-plates mixed yellowish and purple; below, interbrachial spaces purplish, with fine cross lines of white; a broad band of light purple, bordered on either side by light, running whole length of arm; arm-spines white.

Variations. — In a specimen with a disk of 4$^{mm.}$, the spines on the disk were fewer, and were mostly confined to the centre; those on the interbrachial spaces below were merely minute points; the lower arm-plates were longer, and their corners less rounded. In better preserved specimens the ground color was a dull lake-red (yellow ochre and red).

This species is very distinct from others of America in having the arm-plates as long as broad, and only four or five very long, slender arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
144	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.
145	64	2	West Indies.	. . . . .	University Museum, Copenhagen.	"
146	991	1	Carthagena, New Grenada.	. . . . .	A. Schott.	"
			Smithsonian Institution.			
991	. .	4	Carthagena, New Grenada.	. . . . .	A. Schott.	Alcoholic.
1112	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"

Ophiothrix magnifica Lyman.

Ophiothrix magnifica Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 254. 1860.

Special Marks. — A large species; back of disk closely spined; arm-spines stout, round, somewhat tapering; color bluish.

Description of a Specimen. — Diameter of disk, 12.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 5.6$^{mm.}$; width of arm without spines, 2.7$^{mm.}$; length of arm, 70$^{mm.}$; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 2.4 : 2.4. Tooth-papillæ about thirty-six, arranged in two rows of about ten each, which diverge from above downward, and are filled in between by smaller papillæ; the papillæ grow shorter and smaller from above downward. Teeth six, squarish, moderately stout, with rounded cutting edge; uppermost one thin, and so tapering as almost to be sharp. Mouth-shields small, almost circular; length to breadth, 1 : 1.2. Side mouth-shields meeting within. Under arm-plates covered with thick skin, and closely joined, so that their outline is indistinct; in form irregular oval; outer side longer than inner, and slightly re-entering; lateral sides well rounded; length to breadth, .7 : 1.3. Upper arm-plates small, with a strong median ridge; diamond-shaped, with outer angle much rounded, lateral angles sharp, and inner angle very slightly truncated; length to breadth (thirteenth plate), .7 : 1.2. Brachial and interbrachial rays of disk closely beset with round, stout, tapering spines, of very even length; they are covered with minute thorns, and terminate in a rather blunt crown of them; these spines have usually a length of about 1.3$^{mm.}$. Radial

shields much obscured by surrounding spines, but bearing only a few small spines themselves; length to breadth, 3.5 : 1.7. Arm-spines stout, rather blunt, rounded, slightly and regularly tapering, deeply corrugated lengthwise, bearing many small, blunt thorns; upper spines scarcely flattened at all; second and third spines usually longest and stoutest; eleventh joint, eight spines; lengths to that of under arm-plate, 2.4, 2.6, 3.1, 2.1, 2.1, 1.5, .9, .5 : .7. Tentacle-scales distinct, flat, rounded at their outer end. Color, in alcohol: above, disk dull indigo-blue (cobalt and indigo-blue); arms the same, but banded with lighter; usually two or three joints to each band; arm-spines faint blue; below, interbrachial spaces a little lighter than upper surface; under arm-plates variegated with cross lines and specks of white, and of darker and lighter blue, giving the arm a banded appearance.

Variations. — The general color may incline more to greenish-blue, or, on the other hand, to purplish-blue; and the marking of the under arm-plates may form more or less distinct bands. The largest specimen had the disk 14$^{mm.}$ in diameter, and some of the spines on the disk as long as 2.1$^{mm.}$. Many of the arm-spines were tipped with white.

This very beautiful *Ophiothrix* belongs to the group which has only long spines on the back of the disk; it differs from *O. Örstedii* in greater stoutness and shortness of the disk-spines, and in more cylindrical arm-spines; it has more and shorter spines than *O. Suensonii*, and is larger than either of these species.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
150	1043	1	Peru.	. . . . .	Mr. Raymond.	Alcoholic.
			Smithsonian Institution.			
1043	. .		Peru.	. . . . .	Mr. Raymond.	Alcoholic.

Ophiothrix virgata Lyman.

Ophiothrix virgata Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 82. 1861.

Special Marks. — Disk beset with slender spines. Arms twelve times as long as the diameter of the disk; along their upper side, a clear white line, bordered by a narrow blue one on each side.

Description of a Specimen. — Diameter of disk, 6$^{mm.}$; width of arm without spines, 1$^{mm.}$; length of arm, 75$^{mm.}$. Tooth-papillæ thirteen, in horizontal rows of two or three; lowest ones the smallest. Teeth four, very thick and stout, standing close together. Mouth-shields heart-shaped, with a pretty distinct point inward, broader than long; length to breadth, .8 : 1. Side mouth-shields meeting nearly, or quite, within. Under arm-plates four-sided, with cleanly rounded corners; length to breadth (twelfth plate), .6 : .7. Upper arm-plates wider without than within, outer side cleanly curved, lateral sides a little re-enteringly curved, and sloping towards the centre of the arm; length to breadth (eighth plate), .7 : 1. Disk above and below pretty closely covered with short, tapering, thorny spines, the longest 1$^{mm.}$ in length, which nearly obscure the scaling of the disk, which may be distinguished through the skin. Radial shields nearly naked, separated by a single line of spiny scales; length to breadth, 1.8 : 1.2. Arm-spines six, slender, not swelled at the point, upper one commonly longest; lengths to that of under arm-plate, 1.7, 1.7, 1.4, .9, .6, .5 : .6. Tentacle-scales very distinct, round. Color, in alcohol: above, pale blue on the disk, the radial shields with a speck of white at their outer ends; arms obscurely banded with paler and darker blue; along the middle of the arm, a clear line of white, bounded by a narrow blue line on each side; below, interbrachial spaces pale blue, the rest nearly white.

Ophiothrix spongicola must be quite near this species, but its arms are much shorter, and the pattern of color different.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
337	. .	1	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.

Ophiothrix angulata Ayres. (Pl. II. Figs. 1–3.)

Ophiura angulata Say. Journ. Phil. Acad., V. p. 145. 1825.
Ophiothrix angulata Ayres. Proceed. Boston Soc. Nat. Hist., IV. p. 249.
Ophiothrix hispida Ayres. Proceed. Boston Soc. Nat. Hist., IV. p. 249.

Special Marks. — Pale bluish, with a white line along arms, and bands across them. Disk about 6.5$^{mm.}$. Arm-spines numerous; often ten or eleven near base of arm. About eighteen tooth-papillæ.

Description of a Specimen. — Diameter of disk, 6.4$^{mm.}$; outer side of mouth-shield to outer corner of opposite mouth-slit, 2.8$^{mm.}$; width of arm without spines, 1.5$^{mm.}$; length of arm, 38.4$^{mm.}$; distance from outer side of mouth-shield to inner point of tooth-papillæ, to that between outer corners of mouth-slits as 1.6 : 1.4. Tooth-papillæ like a bunch of short, stout, blunt spines, soldered by their sides; arranged in five horizontal rows, of which the three highest have each four spines, the lowest one or two, and the other three; papillæ often irregularly placed, not in rows; the papillæ on the sides of the rows project more towards centre than do the middle ones. Teeth four, highest smallest, all thickened so as to touch, or nearly touch, each other. Mouth-shields closely soldered with side mouth-shields and with surrounding parts; in shape nearly oval, with a slight peak towards mouth; length to breadth, .6 : 1; madreporic shield larger. Side mouth-shields closely soldered with surrounding parts, in shape elongated triangular. Under arm-plates somewhat square; outer side a little re-enteringly curved; laterals rather strongly curved; inner side nearly straight; plates pretty closely soldered with each other and with surrounding parts; innermost plate small, nearly heart-shaped, with its joint inward; second plate contracted at its inner end; general form of other plates square, till near tip of arm, where they gradually get more elongated, their lateral sides straighter, and their outer sides more strongly re-entering; length to breadth (seventh plate), .5 : .6; about two thirds the length of the arm, .4 : .2; close to tip of arm, same proportion, but plates smaller, the breadths as above given; show also the lengths of the outer sides; the breadth of the inner side of the seventh plate is .4$^{mm.}$. Side arm-plates covered with skin, so that their outlines are obscured, ridge bearing arm-spines, high, narrow, and of even width. Upper arm-plates pretty clearly marked, at base of arm; each has four sides, an outer, much curved, an inner, very short, and two lateral, nearly straight; inner side very short, so that plates seem like wedges, with their points turned inward; first two or three plates shorter than those that follow; plates near point of arm much elongated; length to breadth as follows: first plate, .6 : .6; sixth plate, .6 : .8; about two thirds the length of the arm,

.6 : .4 ; close to tip of arm, plates longer in proportion. Along the middle of each plate runs a ridge, and there is therefore a continuous ridge from the base to the point of the arm. Disk, above, with a raised star of ten rays and a small centre ; interbrachial rays high and broad, with a width of 1.2$^{mm.}$ near centre of disk, and of 1.6$^{mm.}$ at its edge ; closely beset with very small, short spines, ending in a triple fork ; about 34 spines to a square *mm.* ; interbrachial rays, meeting in middle of disk, make a centre to the star, having a diameter of 2$^{mm.}$; brachial rays very low and narrow, and tapering to a point before reaching edge of disk ; greatest width, .2$^{mm.}$; each bears a single row of forked spines. Radial shields, length 1.6$^{mm.}$, greatest width 1$^{mm.}$; each has about twelve scattered, forked spines. Besides short, forked spines, there are on the back of the disk a few longer, thorny spines, having a length of .8$^{mm.}$, or 1$^{mm.}$. Interbrachial spaces below have a triangular patch of close-set spines, which is a continuation of the interbrachial ray from above, this patch is bounded by a stripe of bare skin, .8$^{mm.}$, which runs along the edge of the genital slits to the mouth-shields. Arm-spines, number of spines and lengths compared with those of the under arm-plates : second joint, two spines, .4, .4 : .6 ; third joint, four spines, .4, .4, .6, .6 : .6 ; fourth joint, six spines, .4, .6, .6, .8, .8, .8 : .6 ; fifth joint, eleven spines, 1.6, 1.6, 1.6, 1.2, 1.2, .8, .8, .8, .6, .4, .2 : .6 ; sixth joint, ten spines, longest one 2^{mm} ; seventeenth joint, six spines, 1.4, 2.8, 1.4, .6, .4, .2 : .6 ; three fourths out on arm, five spines, 1.4, 2, .8, .4, .4 : .4 ; the lowest spine has here the form of a heavy knife, bearing two or three hooks on its edge ; these hooks continue inwards to about the fiftieth joint from the tip, where they gradually take on the form of true spines ; at the tip of arm, four spines, the lowest a hook. The longer and stouter spines, near base of arm, have usually a thorny, rather blunt end, and twelve or fifteen thorns on each edge. Tentacle-scales, from base of arm quite to the tip there is a small, stunted spine, with two or three thorns at its end, which answers to the tentacle-scale. Color, in alcohol : general tint, a faded, grayish cobalt blue ; under arm-plates and mouth apparatus yellowish-white ; arms banded with darker blue ; interbrachial spaces on back of disk darker than brachial spaces ; a light line running along upper side of arm.

Variations. — The differences in color of this species, when living, are very great. According to colored drawings of about twenty varieties, belonging to Professor Agassiz, the disk may be various shades of vermilion, pink, purple, blue, dull green, brown, and yellow ; the radial shields seem always to differ from the rest of the disk ; the ground color of the arms, also, is usually different from that of the disk, and varies quite as much ; the arms are always banded. In alcohol the color has always a faded look, the specimens being either whitish, or

else dull green or blue. The young, with a disk of 3mm., have arms 16mm. in length; the disk is already closely covered with small spines, each bearing a crown of three long, sharp thorns; the arm-plates are proportionately longer than in the adult, and the arm-spines have rather longer thorns. Very often the adult has only spines of the smaller sort on the disk. Some specimens have the disk as large as 7mm.

O. angulata bears some resemblance to *O. violacea;* the latter, however, has not banded arms, and has no such variety of coloration when living; moreover, *O. angulata* is smaller, has under arm-plates proportionately longer, arm-spines commonly more numerous, and about eighteen tooth-papillæ, while *O. violacea* has as many as thirty. It differs from *O. spiculata* and *O. dumosa* in fewer tooth-papillæ, shorter arm-spines, and in being a smaller species.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
132	. .	12+	Charleston, S. C.	1851.	Prof. Agassiz.	Alcoholic.
133	. .	12+	Charleston, S. C. ?	. . . . .	. . . . .	"
134	. .	12+	Charleston, S. C.	1852.	Prof. Agassiz.	"
135	. .	1	Waccamaw, S. C.	1853.	Prof. Agassiz.	"
390	. .	. .	North Carolina.	. . . . .	. . . . .	"
			Smithsonian Institution.			
982	. .	12+	South Carolina.	. . . . .	Mr. Kurtz.	Alcoholic.

Ophiothrix violacea Müll. & Trosch.

Stella marina minor echinata purpurea? Sloane. Voy. to Jamaica, p. 272, pl. 244, f. 8, 9. 1725.
Stella scolopendroides; *Jamaicensis purpurea?* Linck. De Stel. Mar., p. 51. 1733.
Ophiothrix violacea Müll. & Trosch. Syst. Asterid., p. 115. 1842.
Ophiothrix caribæa Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiothrix Kröyeri Lütken. Vidensk. Meddelelser. Jan., 1856.
Ophiothrix violacea Lütken. Addit. ad Hist. Oph., p. 150 1859.

Special Marks. — Dark-purplish blue, with a white line along the arm. Small, forked spines on the disk, with a few long ones.

Description of a Specimen. — Diameter of disk, 10mm.; from outer side of mouth-shield to outer corner of opposite mouth-slit, 4mm.; width of arm without spines, 2.3mm.; length of arm, 62mm.; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 2 : 1.7. Tooth-papillæ arranged in an oval

figure, about thirty in number; those on sides larger and longer than central ones; lowest ones smaller, and more rounded and spine-like; upper ones larger and more flattened. Teeth three, thin, delicate, flattened, squarish. Mouth-shields diamond oval, with an angle inward and a curve without; length to breadth, 7 : 1.2; madreporic shield larger than others, and rounded. The two plates that join the outer side of the mouth-shield, making thus a bridge between the inner ends of the genital slits, are quite conspicuous. Side mouth-shields triangular, elongated, nearly meeting within mouth-shield proper; they are closely soldered with surrounding parts, and are hard to see except in a dry specimen. Under arm-plates broader than long, with a strongly re-entering curve on outer side; inner side nearly straight; lateral sides curved, or slightly angular; plates near base of arm have their outer side raised a little above succeeding plate; plates within margin of disk narrower, and more closely soldered to each other than those beyond; length to breadth (fourteenth plate), .7 : 1; about two thirds out on arm, plates nearly square, a little longer, however, than broad, with a re-entering curve in outer side, though less strong than in the plates near base of arm. Side arm-plates encroaching so much above as nearly to meet each other, even near base of arm. Upper arm-plates short diamond-shaped, with a slight median ridge; outer and inner angles more or less rounded; length to breadth (seventh plate), .7 : 1.2; about two thirds out on arm, plates have same general form, but are about as long as broad. Disk, above, closely beset with short spines without lateral thorns, each, however, crowned with three or four thorns; less numerous on radial shields; about 36 to a square *mm.*, where they stand thickest. Towards centre of disk a few longer spines, like those of arms, but more slender and shorter. Below, interbrachial spaces covered with spines somewhat longer than the short ones above. Radial shields beset with scattered spines; length to breadth, 2.4 : 1; their interbrachial side is strongly curved; their brachial side nearly straight, or a little re-enteringly curved; where they meet, just at their outer end, they have a slight protuberance; for the rest of their length they are separated by a tapering brachial stripe. Arm-spines about eight, long and slender; largest ones with fifteen to twenty thorns on each edge; lengths to that of under arm-plate as follows: (seventh joint,) 2.5, 3, 2.7, 2.3, 1.6, 1.6, .5 : .7. Sometimes there are as many as eleven spines, but the additional ones are very short, and are the lowest. About half-way out on arm six spines, lowest one broad and flat, with hooks on its edge; four upper ones long. Tentacle-scale minute, sharp, conical, usually simple, sometimes with a crown of two or three microscopic thorns. Color, in alcohol: above, bluish purple; along median line of arm, a narrow stripe of clear white, bounded each side by a dark stripe; two fine white spots on lateral corners; arm-spines

with a purplish tint; below, chewing apparatus yellowish, mouth-shields white, speckled with purplish blue; under arm-plates the same, but, in addition, bordered with pale purplish-blue; interbrachial spaces finely mottled with white and purplish blue.

Variations. — The color differs chiefly in being darker or paler; in the former case, the white spots on the upper arm-plates may be obliterated, and even the longitudinal white line become quite faint. Often the under arm-plates are white through the centre, while the lateral sides are dark blue. The proportions of disk to arms present such differences as the following: 9 : 53, 10 : 44, 7.5 : 42, 5 : 23. Dr. Lütken gives a measurement as high as 10 : 80. The average of seven measurements of the length of under arm-plates compared to that of longest arm-spines, near base of arm, was .7 : 3.1; the extremes were .6 : 3 and .8 : 3.2. The spines on the upper surface of the disk vary somewhat in number and also in the length of their thorns; those below vary very much in number, being sometimes closely set, sometimes almost wanting, sometimes thorny, sometimes smooth. The side mouth-shields sometimes quite meet within.

This species is apparently much more common at St. Thomas and the neighboring islands than in Florida. Certainly in Key West it is comparatively very rare. It is distinguished from other species as follows: from *O. Örstedii*, by short, forked spines of disk, and different pattern of color in alcohol; from *O. Suensonii*, by short, forked spines of disk, and a white median line along arm, instead of a dark one; from *O. lineata*, by more slender and numerous arm-spines, and by short, forked spines of disk; from *O. angulata*, by greater size (7$^{mm.}$ diameter of disk, corresponds in *O. angulata* to about 10$^{mm.}$ in *O. violacea*), by fewer long spines on disk, and by a much darker pattern of color, when in alcohol.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
137	. .	4	Jeremie, Hayti.	. . . . .	Dr. D. F. Weinland.	Alcoholic.
138	. .	7	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
139	66[a]	2	Rio Janeiro.	. . . . .	Univ.Mus.Cop'hagen.	"
140	66[b]	4	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	"
(?) 141	. .	12+	Charlotte's Harbor, Fla.	. . . . .	G. Wurdeman.	"
			Smithsonian Institution.			
1017	. .	1	West Indies.	. . . . .	Univ.Mus.Cop'hagen.	Alcoholic.
1016	. .	1	Rio Janeiro.	. . . . .	Univ.Mus.Cop'hagen.	"
1159	. .	3	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1088	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.
1111	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Alcoholic.

Ophiothrix spiculata LeConte.

Ophiothrix spiculata J. L. LeConte. Proceed. Phil. Acad., V. p. 318. 1851.
Ophiothrix spiculata Lütken. Addit. ad Hist. Oph., p. 151. 1859.

Special Marks. — Pale cobalt-blue in alcohol; longest arm-spines to under arm-plates as 3.1 : .6. Disk sometimes as large as 11.5^{mm}; specimens variable.

Description of a Specimen. — Diameter of disk, 9$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 4$^{mm.}$; width of arm without spines, 2$^{mm.}$; length of arm, 51$^{mm.}$; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 2 : 2. Tooth-papillæ, lowermost ones rounded, small, stout, making a cluster of about twelve; between this cluster and the teeth there are six very large, stout papillæ arranged in pairs. Teeth five, flattened, squarish, with rounded edge unusually stout and thick; uppermost one smaller and more tapering. Mouth-shields broader than long, with a slight peak inward; without, rounded; length to breadth, .8 : 1.4. Side mouth-shields meeting within. Under arm-plates broader than long, inner side shorter than outer, outer side a little re-enteringly curved, inner side nearly straight, lateral sides irregularly curved, outer corners strongly rounded; length to breadth (eleventh plate), .6 : 1; first four or five plates smaller and more square. Upper arm-plates with a median ridge, diamond-shape, with lateral corners acute, outer corners rounded, and inner corner truncated; length to breadth (third plate), .6 : 1. Brachial and interbrachial rays of disk closely beset with small and large spines, the small being usually about .4$^{mm.}$ long, surmounted by a crown of from three to six thorns, and sometimes with one or two thorns on their sides; the large ones are sometimes as long as 1.7$^{mm.}$, similar in shape to arm-spines, but more slender, and bearing from five to eight fine thorns on each edge, and three or four at the tip. In interbrachial spaces below, only a few short, scattered spines; none at all close to mouth-shields. Radial shields large; length to breadth, 2.5 : 2; though obscured by the surrounding spines, they are themselves nearly naked, bearing only a few short spines, which are chiefly on the inner angle; they touch each other with their outer end, which is a little swelled, and has a short, narrow, raised edge. Arm-spines near base of arm, usually seven, rather slender, slightly tapering; longest ones with from fourteen to twenty-four fine thorns on each edge, and a cluster of still finer ones at the end; upper spine most tapering; second one longest, and cut off pretty square at the end, as are also the third and fourth spines; second spine often has a

length as great as 3.5mm., and sometimes even 3.8mm.; eighth joint, seven spines; lengths to that of under arm-plate, 3, 3.2, 2.3, 1.5, 1.6, .4 : .6. Tentacle-scale, instead of being spiniform, is flat and square, ending in four or five microscopic points. Color, in alcohol: above, faded cobalt-blue, with a brownish tinge towards centre of disk; along centre of arm a faint line of lighter; below, interbrachial spaces pale cobalt-blue; other parts the same, but lighter. In the living animal "the body is dark fuscous above, and pale beneath; every fifth ventral plate on the arms is sometimes red or brown," and the apex of the arm-spines is frequently black (LeConte); or the main color may be greenish, the upper arm-plates violet, and every fourth joint red (Dr. Örsted).

Variations. — Either this species is very variable, or else there are two or more species at present confounded under it. The specimen above described may be considered as the type; from which, however, there are considerable deviations, both in the armature of the disk and the length of the arm-spines. A specimen with a disk of 8mm. had the disk closely covered with short spines, bearing each a crown of from three to six thorns; there were no long spines on the disk; the seventh arm-joint bore eight spines, whose proportions to that of the lower arm-plate were as follows: 1.8, 2.2, 1.8, 1.2, .7, .6, .5, .4 : .6. The second spine was remarkably flat, and was cut square off at the end; it had thirteen thorns on each side. Another specimen, with a diameter of disk of 11.5mm, had from seven to nine spines on the basal joints; the length of the three upper ones to that of the lower arm-plates being about 4.7, 4.5, 4.1 : .7. This specimen had the radial shields nearly naked, but the rest of the disk pretty closely covered with short and long spines. A comparison of the length of the longest arm-spines with that of the lower arm-plates gave, in eight well-grown specimens, an average of 3.1 : .6, the extremes being 5 : .7 and 2.4 : .6. In other words, the disk may have many or few spines, and may have either one or two sorts; and the arms may have spines of from four to seven times the length of a lower arm-plate, and differing more or less in shape. A young specimen had the disk 2mm., arms 10mm., arm-spines .7mm., under arm-plates .2mm.; the arm-spines had five thorns on each edge; the disk was thinly covered with short spines; the under arm-plates were longer than broad, widest without, and had a notch in their outer side.

O. spiculata resembles *O. violacea* and *O. angulata*, but differs from both in the greater proportionate length of the arm-spines; from *O. Örstedii* it is distinguished by different armature of the disk, different pattern of coloration, and longer arm-spines. It is further remarkable as a *variable* species.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
147	. .	12+	Panama.	. . . . .	Alex. Agassiz.	Alcoholic.
148	. .	12+	Panama.	. . . . .	Dr. John LeConte.	Dried.
391	. .	. .	Panama.	. . . . .	Dr. Sternberg.	Alcoholic.
			Smithsonian Institution.			
1019	. .	1	Panama.	. . . . .	Dr. Sternberg.	Alcoholic.
1045	. .	2	Panama.	. . . . .	Rev. T. Powell.	"
1183	. .	5	Panama.	. . . . .	Dr. LeConte.	Dried.
1091	. .	2	Panama.	. . . . .	Mr. Edwards.	"
1095	. .	1	Panama.	. . . . .	Mr. Akhurst.	"
1187	. .	1	West Coast Nicaragua.	. . . . .	Capt. Dow.	"

Ophiothrix dumosa Lyman.

Ophiothrix dumosa Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 252. 1860.

Special Marks. — Upper arm-spine longest. Spines on disk of several sizes; stout. Color dull blue.

Description of a Specimen. — Diameter of disk, 11.5$^{mm.}$; from outer side of mouth-shield to outer corner of opposite mouth-slit, 5$^{mm.}$; width of arm without spines, 2.2$^{mm.}$; length of arm, 72$^{mm.}$; distance from outer side of mouth-shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 2.5 : 2.5. Teeth six, squarish, thick; cutting edge a little rounded, sometimes split in two; upper one rather narrower and more tapering. Tooth-papillæ about thirty-eight, arranged in two diverging, principal rows, between which are included some smaller ones; these two rows start, just below the teeth, with a pair of large, flat papillæ, like a tooth split in two; these are followed by a similar pair, after which the two rows diverge, growing smaller as they pass lower down, and ending in papillæ no larger than those which serve to fill in the middle space; in each of these principal rows there are about nine papillæ. The arrangement is the same in *O. spiculata*. Mouth-shields oval heart-shaped, with a decided peak directed inward; length to breadth, 1.3 : 1.8. Side mouth-shields rather narrower than is common in the genus, meeting within. Under arm-plates much broader than long, hexagonal, with angles more or less rounded; first four plates smaller than those beyond, and much more rounded; most of the plates on the first third of the arm are hexagonal, with

pretty acute angles; outer side sometimes a little re-enteringly curved; other sides straight; length to breadth (twelfth plate), .7 : 1.2. Upper arm-plates diamond-shaped, with inner angle truncated, lateral ones usually acute, and outer one more or less rounded; on the median line a ridge; length to breadth (fifth plate), .7 : 1.3. Brachial and interbrachial rays of disk closely beset with stout spines, of several sizes, most of them long; the longest 1.7$^{mm.}$, the shortest .3$^{mm.}$. There seem to be no such short spines, bearing a crown of slender thorns, and remaining permanently small, as in *O. spiculata;* but the smaller spines seem only partly-grown large ones. The largest are stout and round, and have rows of five or six thorns on their sides; they usually end in three blunt thorns; the smaller ones usually are very thick at the base, but above the first thorn grow suddenly smaller, and taper to a somewhat blunt, thorny end; these have rows of three or four thorns on their sides; the smallest spines are little, stout cylinders, ending in a conical clump of nine or ten short thorns; rarely this clump has an even top, and not more than six thorns. Radial shields nearly bare, with only a few spines on their inner ends and sides; outer ends touching each other; where they overhang the arm there is a short, narrow, raised edge, which is white; length to breadth, 3.2 : 1.6. Spines on interbrachial spaces below more slender and scattered, not extending quite to mouth-shields. Arm-spines rounded and stout at their bases, tapering regularly to a blunt point, but little flattened, ending in a crown of short, blunt thorns; thirteenth joint, eight spines; lengths to that of under arm-plate, 3.5, 2.2, 2.5, 2.5, 1.8, 1.5, 1, .6 : .7. Upper spine always longest and stoutest, with rows of about twenty-four minute thorns on its sides; it sometimes has a length of 4.5; near base of arm usually about 3.8. Tentacle-scales unusually large, though varying somewhat in size; instead of being like rudimentary spines, they commonly have the regular oval form of a true scale; length, .2$^{mm.}$. Color, in alcohol: above, disk dull cobalt-blue, approaching lead color; radial shields lighter, each with three or four large dark spots; upper arm-plates faint bluish, with a darker spot on each side; along median line of arm, an indistinct stripe of whitish; arm-spines dark at tips; below, interbrachial spaces similar to upper surface; mouth-shields and under arm-plates irregularly edged with whitish, and spotted with dark blue.

Variations. — Another specimen had but few of the longest spines on the disk, most of them being of the second or of the smallest size; the radial shields had no distinct spots, and the under arm-plates were bright blue, with some bandings of whitish. The side mouth-shields sometimes do not meet within.

This species might be called a coarse edition of *O. spiculata*, from which it is distinguished chiefly by the armature of the disk, which is

coarser, and of a different character; the arm-spines, also, are rather stouter, and the under arm-plates more regular and angular. It is a larger species than *O. violacea* or *O. angulata*, and differs from them in coarser spines on the disk, and proportionately longer arm-spines.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
149	1049	1	San Diego, Cal.	. . . . .	Mr. Cassidy.	Alcoholic.
338	. .	1	Guayamas, Gulf of California.	. . . . .	Capt. Stone.	"
			Smithsonian Institution.			
1049	. .	2	San Diego, Cal.	. . . . .	Mr. Cassidy.	Alcoholic.

Ophiothrix lineata LYMAN.

Ophiothrix lineata LYMAN. Proceed. Boston Soc. Nat. Hist., VII. p. 201. 1860.

Special Marks. — Brownish red, with a black line along the upper side of the arm. Arm-spines usually six, stout.

Description of a Specimen. — Diameter of disk, $10^{mm.}$; from outer edge of mouth-shield to outer corner of opposite mouth-slit, $4.5^{mm.}$; width of arm without spines, $2^{mm.}$; length of arm, $63^{mm.}$. Tooth-papillæ fine, numerous, cylindrical, resembling short, blunt spines. Mouth-shields broad oval, with a slight peak toward mouth; length to breadth, 1 : 1.5. Disk, above, with large radial shields, which are smooth, or very nearly so, shaped like an elongated triangle, the acute angle being turned inward, separated by a distinct stripe; length to breadth, 2.8 : 1.7; the narrow brachial and broad interbrachial spaces form ten stripes, radiating from the centre; both centre and stripes are covered with elongated scales (only to be seen on dried specimens), and these again bear many little grains, each with a crown of thorns; below, interbrachial spaces quite naked. Upper arm-plates broad hexagonal, with corners a little rounded, the two side angles more acute than the others; length to breadth, .7 : 1.5. Under arm-plates nearly oval, but with some indications of angles; length to breadth, .8 : 1.2. Arm-spines rather stout, flattened, cut off square at the end, varying in length; about six in number on joints close to disk; two upper ones

much the stoutest and longest, and of about equal length, viz. 2.7mm.; sometimes, however, the upper one is very short and stout; three lowest spines minute and slender, the longest not longer than .8mm.; a little farther out on arm only five spines, two large, one medium, and two small. The large spines have on their flat sides diagonal rows of smooth, microscopic tubercles, which give them a wavy or corrugated appearance. One tentacle-scale, represented by a microscopic thorn. Color, in alcohol: above, disk uniform light Indian-red; arms dull purplish, with a very distinct longitudinal line of black, bounded on each side by a clear white line; spines glassy, with a pink hue; below, mouth apparatus and under arm-plates white; interbrachial spaces Indian red without, but yellowish toward the mouth.

Variations. — The number of spines sometimes rises to nine, of which five are large, and four very small. The mouth-shields, instead of being regularly oval, may have their lateral corners quite sharp.

This species may be readily distinguished from all others of Florida, by the granulation of the disk, the character of the spines, and the regular form of the upper arm-plates.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
136	. .	1	Florida.	. . . . .	Prof. Agassiz.	Alcoholic.

Ophiothrix demessa Lyman.

Ophiothrix demessa Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 82. 1861.

Special Marks. — Upper surface of disk, with radial shields closely covered with minute spines, bearing a crown of thorns. Arms about nine times as long as the diameter of the disk. Little thorny spines on the upper arm-plates.

Description of a Specimen. — Diameter of disk, 10.5mm.; width of arm without spines, 1.9mm.; length of arm, 97mm. Tooth-papillæ fifteen, unusually stout, standing on a level with each other, arranged in horizontal rows of from two to four, according to size; upper ones stoutest. Teeth four, thick, stout, standing well apart. Mouth-shields much

broader than long, oval, with a faint point inward; length to breadth, .7 : 1.1. Side mouth-shields very small and narrow, not meeting within. Under arm-plates small, squarish, with rounded corners, rather broader without than within; length to breadth, .6 : .6. Upper arm-plates regular and well marked, much wider than long, wider without than within, lateral corners unusually sharp, outer side cleanly curved; length to breadth, .6 : 1.2; their surface is closely covered with minute thorny spines, like those of the disk, but smaller. Disk closely beset with short, minute spines, which are smooth on the sides, but have a crown of four to six thorns; the radial shields also are covered so as to look like the rest of the disk; below the spines are smaller, more scattered, and more pointed. Arm-spines very slender and elegant, tapering, pointed, uppermost and lowest ones shortest; on the basal joints commonly eleven; lengths to that of under arm-plate, .6, 1, 1.4, 1.6, 1.6, 1.6, 1.6, 1.2, .9, .6, .3 : .6. Tentacle-scale small and rounded. Color, in alcohol: above, faint purplish-blue, arms banded with darker, and a broken stripe of the same running along the middle line; interbrachial spaces below same as above; the rest lighter.

Variations. — In specimens that have the disk-spines less closely set, the disk is seen to be covered with thin, small, rounded scales; the outlines of the radial shields, also, may be seen. The upper arm-plates are hexagonal, having the outer side in three lines. The arms in some specimens attain a length twelve times that of the disk diameter.

Ophiothrix demessa has a very soft, puffed disk, which commonly wrinkles in alcohol; it somewhat resembles *O. longipeda* and *O. parasita*, but has little thorny spines on the upper arm-plates, and is otherwise distinguished.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
151	. .	1	Hilo, Sandwich Islands.	. . . . .	A. Garrett.	Alcoholic.
334	. .	2	French Frigate Shoal.	. . . . .	A. Garrett.	"
335	. .	3	Maui, Sandwich Islands.	. . . . .	A. Garrett.	"
336	. .	. .	Kingsmills Islands.	. . . . .	A. Garrett.	"

Ophiothrix propinqua Lyman.

Ophiothrix propinqua Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 83. 1861.

Special Marks. — Disk sparsely granulated, and covered above with narrow scales, which form five to seven radiating rows in the interbrachial spaces. Radial shields naked.

Description of a Specimen. — Diameter of disk, 11$^{mm.}$; width of arm without spines, 1.6$^{mm.}$; length of arm, 125^{mm}. Tooth-papillæ standing nearly on a level with each other, thirteen to fifteen, in horizontal rows of two, or more commonly three; the lowest ones smallest. Teeth four, very thick and stout, the highest one smallest. Mouth-shields small, irregular oval, or oval heart-shaped, broader than long; length to breadth, .7 : 1.2. Side mouth-shields short and wide, not meeting within. Under arm-plates oval, broader than long, the outer side a little re-enteringly curved; length to breadth (twelfth plate), .6 : .8. Upper arm-plates pointed oval, much broader than long; length to breadth, .6 : 1.5. Disk covered above with narrow, elongated, rather indistinct scales, arranged in parallel, radiating rows; from five to seven such rows in each interbrachial space, and a single row of three or four scales between each pair of radial shields; these scales bear a few rough grains; outside each radial shield a row of roundish scales; interbrachial spaces below covered with very short spines. Radial shields smaller than usual, regular triangular, quite naked; length to breadth, 2.8 : 1.6. Arm-spines near base of arm, from five to seven, the two or three lowest very small, the larger ones swelled at the tip; lengths to that of under arm-plate, 2.2, 2.5, 2.2, 1.1, .6 : .6. Tentacle-scale very small, somewhat pointed. Color, in alcohol: above, disk bright Prussian-blue, varied with whitish; outer tips of radial shields white; arms obscurely banded with paler and darker blue; a longitudinal stripe of dark blue along the middle, and a small white spot between each pair of upper arm-plates; below, interbrachial spaces dark blue; mouth parts and under arm-plates nearly white.

Variations. — Another specimen had the disk of a more intense blue, and the white spots on the arms were nearly wanting.

This species approaches *O. nereidina*, but has more rows of scales on the back of the disk; the arms, also, are proportionately shorter.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
153	. .	. .	Kingsmills Islands.	. . . . .	A. Garrett.	Alcoholic.

Ophiothrix Cheneyi Lyman.

Ophiothrix Cheneyi Lyman. Proceed. Boston Soc. Nat. Hist., VIII. p. 84. 1861.
Ophiothrix hirsuta? Müll. & Trosch. Syst. Asteriden, p. 111.

Special Marks. — Radial shields closely granulated; disk beset with thorny stumps. Length of arms about nine times the diameter of disk.

Description of a Specimen. — Diameter of disk, 21$^{mm.}$; width of arm without spines, 3.6$^{mm.}$; length of arm, 170$^{mm.}$. Tooth-papillæ very close set; they form, as usual, a vertical oval, bordered by a projecting margin of about twenty-six papillæ, the centre being filled in with smaller and lower papillæ. Teeth four or five. Mouth-shields nearly as long as broad, heart-shaped, with a pretty acute point inward; length to breadth, 2.3 : 2.5. Side mouth-shields somewhat variable, more or less closely soldered to the mouth-shields. Under arm-plates partly separated by transverse furrows, rectangular, broader than long, re-enteringly curved outside; length to breadth (tenth plate), 1 : 1.3. Upper arm-plates much broader than long, oval, well marked, with a distinct longitudinal rib, sometimes a dent in the outer side, surface bearing microscopic granulations; length to breadth (twelfth plate), 1.1 : 2.8. Disk, above, closely beset with little stumps, thorny on their tops and sides, the longest of them .5$^{mm.}$ long; below, interbrachial spaces with scattered stumps, which near the mouth-shields are more pointed and fewer. Radial shields indistinct, from being covered with large, rough grains, about 35 to a square *mm.* Arm-spines nine; the third, fourth, and fifth longest, pretty stout, somewhat thickened at the point; the three under ones very small, as also the upper one, which is not always found; lengths to that of under arm-plate, .5, 2.9, 3, 3.1, 3.1, 2, 1.5, 1.2, .5 : 1.2. Tentacle-scales oval; small, but distinct. Color, in alcohol: above, disk rich Prussian blue, speckled with white; a light spot on each radial shield; arms indistinctly banded with darker and lighter blue; along the middle a fine white line, bordered on each side with

a band of blue; below, disk pale blue, arms mottled and speckled with dark and light blue; arm-spines transparent, nearly white; the points of the larger ones brownish.

Ophiothrix Cheneyi stands near *O. longipeda*, but has arms only about half as long, and the upper arm-plates are oval, while in *O. longipeda* they are cleanly angular and quite smooth. It is distinguished by its large size and its broad, flat arms, bearing regular and well-marked upper arm-plates.

An examination of the original in the Berlin Zoölogical Museum (No. 1000) has shown me that Müller's *O. hirsuta* stands much nearer the present species than his description would indicate. This specimen is in alcohol, and was brought from the Red Sea by Hemprich and Ehrenberg. It has the large, puffy disk usual in *O. longipeda*. Two other specimens, dry (No. 1002), also from the Red Sea, are likewise labelled *O. hirsuta*, and, according to my notes, agree well with *O. Cheneyi;* but are *not* clearly the same species as the original above mentioned. The point must therefore stand in doubt till the specimens can be compared side by side. In the Jardin des Plantes is an *Ophiothrix* which seems the same as the original of *O. hirsuta*. It has the same puffy disk, and was brought from the same locality by Botta.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
152	. .	2	Zanzibar.	. . . . .	G. A. Cheney.	Alcoholic.
386	. .	. .	Zanzibar.	. . . . .	E. Ropes.	"
387	. .	. .	Zanzibar.	. . . . .	Capt. Webb.	"
388	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"
389	. .	. .	Zanzibar.	. . . . .	C. Cooke.	"

Ophiothrix longipeda Müll. & Trosch.

Ophiura longipeda Lamk. Hist. Anim. s. Vert., II. p. 544.
Ophiothrix longipeda Müll. & Trosch. Syst. Asteriden, p. 113.

The original of Lamarck, in the Jardin des Plantes, is a dried specimen from the Ile de France. The arms are eighteen times the diameter of the disk. This species is a near relation of *O. hirsuta* and *O. Cheneyi*, with similar flat arms and horizontal spines. But

the angular form of the upper arm-plates readily distinguish it from these latter, which have the plates considerably curved.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
383	. .	. .	Society Islands.	. . . . .	A. Garrett.	Alcoholic.
384	. .	. .	Society Islands.	. . . . .	A. Garrett.	"
385	. .	. .	Zanzibar ?	. . . . .	Salem Norm. School.	"

OPHIOMYXA Müll. & Trosch.

Type of the Genus, *O. pentagona* Müll. & Trosch.

Disk and arms wholly covered with a thick, naked skin. No tooth-papillæ. Mouth-papillæ and teeth in the form of flattened lobes, with saw-like cutting edges. Arm-spines stout, bulging at the base, thorny at the point, covered round the base with thick skin; near the tip of the arm, the lower arm-spine has hooks along its edge. Arms rounded; arm-plates imperfectly developed. No tentacle-scales. Two genital slits, beginning outside the mouth-shield.

SPECIES HEREIN DESCRIBED.

Ophiomyxa flaccida.
Ophiomyxa pentagona.

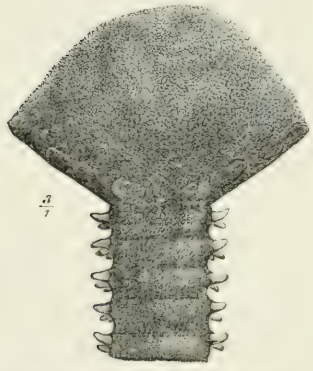
Ophiomyxa flaccida Lütken. (Pl. II. Fig. 6; Figs. 18, 19.)

Ophiura flaccida Say. Journ. Phil. Acad., V. p. 151. 1825.
Ophiomyxa caribœa Lütken. Vidensk. Meddelelser. March, 1856.
Ophiomyxa flaccida Lütken. Addit. ad Hist. Oph., p. 138.

Special Marks. — Color, alive, lake-red or orange; in alcohol, olive green or bright green, sometimes mottled with lighter. Four to six arm-spines. Arms four or five times as long as diameter of disk.

Description of a Specimen. — Diameter of disk, 22mm.; from outer side of mouth-shield to outer corner of opposite mouth-slit, 10mm.; width of arm without spines, 4.5mm.; length of arm, 102mm.; distance from outer side of mouth-shield to inner points of teeth, to that between outer corners of mouth-slits, 4.2 : 4.6. Mouth-papillæ, four to each side of the angle of the jaw; the outer one is, however, rudimentary, and has no saw-like edge; the others are of about equal size, but the two inner ones have their saw-like edge more coarsely divided than the second one. Teeth eight, closely resembling mouth-papillæ; the upper ones with the cutting edge more rounded and nearly smooth. Mouth-shields and side mouth-shields without distinct outline, except in dried specimens; the former are rounded diamond-shape; length to breadth about 2 : 1.7. Side mouth-shields long triangular, nearly meeting within. Under arm-plates, in dried specimens, are faintly indicated by an oval outline, with a notch in the outer side; length to breadth about 1 : 1.5. Upper arm-plates, in dried specimens, appear as transverse, elongated, oval ridges, with sharp lateral corners. Skin of the disk somewhat wrinkled. Arm-spines four, short, flattened, conical, covered nearly to the tip with skin; their thorns numerous; second joint, one spine; third joint, two spines; fifth joint, three spines; ninth joint, four spines; lengths to that of the joint (twelfth joint), 1.3, 1.1, 1.1, 1.1 : 2. The under arm-spine, near the tip of the arm, has four or five little hooks along its edge. Genital slits short, reaching only one half or two thirds the distance to the margin of the disk, furnished with a small lobe near the mouth-shields. Color, in alcohol: above, dirty olive-green, with a few irregular rings of yellowish towards ends of arms; centre of disk

Fig. 18.



Ophiomyxa flaccida. (Upper side.)

Fig. 19.

Ophiomyxa flaccida.
Chewing Apparatus from below.

inclining to yellowish green; below, interbrachial spaces like upper surface; the other parts pale sap-green.

Variations. — The number of arm-spines varies from four to six, or even seven; and this does not seem entirely to depend on size. The color, in alcohol, is usually some shade of green, either plain sap or olive green, or bright green mottled and banded with yellowish. Occasionally the color of the upper parts is deep brownish-green. Lütken's figure, which is not correctly drawn, gives the color as red (burnt-lake). A colored drawing of the living animal, belonging to Professor Agassiz, is yellowish orange (yellow ochre and orange chrome), with a few lighter bands near the ends of the arms. Probably the color varies through several tints of red and of orange.

This species has been taken, in from three to five fathoms of water, at Santa Cruz and St. Thomas (Örsted, Riise). At the latter place Mr. Riise has found it in the holes made in corals by boring mollusks. It is not uncommon on the coast of Florida, near low-water-mark.

Say's description was evidently from a dried specimen, as he mentions the row of overlapping scales along the upper margin of the disk.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
404	. .	. .	Hayti.	. . . . .	Dr. Weinland.	Alcoholic.
155	. .	1	Key West, Fla.	Mh. 6, 1858.	J. E. Mills.	"
156	. .	5	Florida.	. . . . .	Prof. Agassiz.	"
157	. .	1	Tortugas, Fla.	Apr. 24, '58.	J. E. Mills.	"
158	. .	1	Key West, Fla.	Jan. 28, 1858.	J. E. Mills.	"
159	. .	2	Cape Florida.	Apr. 1858.	G. Wurdeman and J. E. Mills.	"
160	. .	6	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
161	. .	12+	Florida.	. . . . .	G. Wurdeman.	"
162	. .	3	West Indies.	. . . . .	University Museum, Copenhagen.	"
163	. .	1	Florida.	. . . . .	G. Wurdeman.	Dried.
164	. .	2	. . . . .	. . . . .	. . . . .	"
353	. .	1	Jamaica.	. . . . .	Amherst College.	"
			Smithsonian Institution.			
1044	. .	4	Cape Florida.	. . . . .	G. Wurdeman.	Alcoholic.
988	. .	1	Cape Florida.	1851.	. . . . .	"
1042	. .	1	Florida.	. . . . .	. . . . .	"
983	. .	1	Tortugas, Fla.	. . . . .	Dr. Whitehurst.	"
1076	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1087	. .	1	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1103	. .	2	St. Thomas, W. I.	. . . . .	A. H. Riise.	"
1155	. .	4	St. Thomas, W. I.	. . . . .	A. H. Riise.	Dried.

Ophiomyxa pentagona Müll. & Trosch.

Ophiura pentagona Lamk. An. s. Vert., II. p. 546.
Ophiomyxa pentagona Müll. & Trosch. Syst. Asterid., p. 108.

LIST OF SPECIMENS.

Catalogue Number.	Original Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
		Museum of Comparative Zoölogy.			
429	. .	. .	Alger.	. . . . .	Jardin des Plantes.	Alcoholic.

ASTROPHYTON Linck.

Type of the Genus, *A. arborescens.**

Disk and arms covered with thick skin, without scales. Radial shields extending nearly or quite to the centre of the disk, and forming more or less elevated radial ribs. Two short genital slits in each interbrachial space, lying close to the margin of the disk. Teeth, tooth-papillæ, and mouth-papillæ all similar and spiniform. Arms forked many times. No arm-spines, except at the tips of the branches, where they have the form of microscopic hooks. Tentacle-scales. Under and side arm-plates very small, and buried beneath the skin of the under side of the arm.

SPECIES HEREIN DESCRIBED.

Disk entirely granulate above; grains flat; ribs low,	*A. arborescens.*
Disk entirely granulate above; ribs distinct,	*A. Lamarckii.*
Only ribs closely granulate,	*A. eucnemis.* / *A. Caryi.*
Ribs with a few short, irregular spines,	*A. Agassizii.*
Disk above closely beset with thorny stumps,	*A. Linckii.*
Disk closely beset above with little thorny spines,	*A. clavatum.*
High ribs bearing a few clavate stumps,	*A. costosum.*

* As the specific identification of Linck's plates cannot now be made, I have taken the oldest described species, *Stella Arborescens* Rond., as the generic type.

Astrophyton arborescens Müll. & Trosch.

Stella arborescens Rondelet. De Pisc. Mar., p. 121. 1554.
Euryale costosum Lamk. Hist. Anim. s. Vert., II. p. 538. 1816.
Astrophyton costosum Agass. Mém. de la Soc. Sciences Nat. Neuchatel, p. 11. 1839.
Astrophyton arborescens Müll. & Trosch. Syst. Asterid., p. 124. 1842.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
472	. .	1	Mediterranean.	. . . . .	. . . . .	Dried.
437	. .	1	Mediterranean.	. . . . .	Jardin des Plantes.	Alcoholic.

Astrophyton Lamarckii Müll. & Trosch.

Asterias caput-medusæ? Linn. Fauna Suecica. 1761. No. 2115.
Astrophyton Lamarckii Müll. & Trosch. Syst. Asterid., p. 123. 1842.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
463	. .	1	North Europe.	. . . . .	Prof. Sars.	Alcoholic.

Astrophyton eucnemis Müll. & Trosch.

Zottenkopf Knorr. Deliciæ Nat. Select., II. p. 34, Pl. G, figs. 1 and 2. 1787.
Asterias caput-medusæ Fabricius (*non* Linn.). Fauna Grœnlandica, No. 367.
Asterias caput-medusæ Dewhurst. Nat. Hist. Ord. Cetacea.
Astrophyton eucnemis Müll. & Trosch. Syst. Asterid., p. 123. 1842.
Astrophyton eucnemis Lütken. Addit. ad Hist. Oph., p. 70.

Special Marks. — Disk granulated. Radial ribs more or less closely granulated; the grains, in the adult, being about the size of those on the upper surface of the arms, but larger in younger specimens. Below, interbrachial spaces either apparently naked, or with very few scattered grains.

Description of a Specimen. — Diameter of disk, 87mm.; from outer side of madreporic shield to outer corner of opposite mouth-slit, 23mm.; breadth of arm inside the first fork, 20mm. Distances from each fork to the next beyond: —

First	fork to	second, ...	19mm.
Second	" "	third, ...	17 "
Third	" "	fourth, ...	23 "
Fourth	" "	fifth, ...	32 "
Fifth	" "	sixth, ...	28 "
Sixth	" "	seventh, ...	30 "
Seventh	" "	eighth, ...	27 "
Eighth	" "	ninth, ...	17 "
Ninth	" "	tenth, ...	17 "
Tenth	" "	eleventh, ...	15 "
Eleventh	" "	twelfth, ...	15 "
Twelfth	" "	thirteenth, ...	17 "
Thirteenth	" "	fourteenth, ...	9 "
Fourteenth	" "	fifteenth, ...	13 "
Fifteenth	" "	end, ...	1 "
			280mm.

Distance from outer side of madreporic shield to inner points of tooth-papillæ, to that between outer corners of mouth-slits, 15 : 8. Mouth-papillæ, tooth-papillæ, and teeth, about twenty in all; sharp, rather slender, spine-like; the longest 2.5 long; those near the outer corners of the mouth-slits smaller. Madreporic shields three (there is commonly but one), like irregular, raised scars, broader than long, often broken. Under sides of arms covered with microscopic granulation, which looks smooth to the naked eye. Upper surface and sides of arms covered with distinct grains, which are pretty closely set on the upper surface, but more scattered on the sides; on the fine terminal branches they appear as a regular double row of large, prominent grains, each grain bearing a little hook; the tendency to arrange themselves in vertical rows may be noticed even at the base of the arm. Interbrachial spaces of disk above, and brachial spaces between the radial ribs, covered with scattered grains; in the centre of the disk, grains closer and rather larger; round the margin of the disk a sort of belt of close-set grains; interbrachial spaces below apparently naked, but really covered with microscopic grains. Radial ribs moderately raised, rounded, and without sharp edges, reaching not quite to the centre; length to breadth, 43 : 9; pretty closely covered with fine grains, which are about the size of those on the arms, and are more numerous along the margins of the ribs; on the outer end, grains larger, and almost like small, blunt spines; just over the arm the end of the rib is naked. Tentacle-scales spiniform, much like the teeth in shape and size; within the disk only two or three to each pore, and on the one or

two innermost pores, none at all; outside the disk, on the chief stems and branches, usually four scales at each pore. Color, in alcohol: dark brown.

Variations. — In smaller specimens the disk granulation is more distinct and better defined; the radial ribs are very closely covered with large, rounded, regular grains, which are larger than those of the interbrachial spaces or of the upper surface of the arms. A specimen with a disk of 24mm., had arms with eight forks. A young one, having a disk of 5.5mm., had arms 17mm. long; distance from disk to first fork, 4mm.; first fork to second, 6mm.; second to third, 5mm.; third to end, 2mm. The back of the disk was covered with smooth, close-set, rounded grains, whereof some were larger than others. The radial ribs were faintly indicated, and only at their outer end. The upper surface of the arms is covered with large grains also. Each mouth-angle carried three or four stout, conical teeth, but there were no papillæ on the sides of the mouth-angle. The tentacle-scales were also very stout. The sides of the arms bore no grains, but little, flattened spines, arranged in a row; all of them, except those at the base of the arms, bearing little hooks. A specimen with a disk of 38mm. had the following proportions of the arms: —

First	fork to	second, ...	12mm.
Second	" "	third, ...	23 "
Third	" "	fourth, ...	24 "
Fourth	" "	fifth, ...	24 "
Fifth	" "	sixth, ...	21 "
Sixth	" "	seventh, ...	16 "
Seventh	" "	eighth, ...	18 "
Eighth	" "	ninth, ...	13 "
Ninth	" "	tenth, ...	13 "
Tenth	" "	eleventh, ...	9 "
Eleventh	" "	end, ...	1 "
			174mm.

This species has been dredged in four hundred and fifty fathoms, and, according to Dewhurst, even as deep as one thousand fathoms. It has been found on the coast of Greenland (Olric and Hollböll) and at Newfoundland. *A. eucnemis* resembles *A. Caryi*, but the latter has the space at the base of the mouth-angle distinctly granulated, as also the edges of the genital slits; the tentacle-scales, also, are shorter and stouter.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
461	. .	3	Greenland.	. . . . .	Prof. Eschricht.	Alcoholic.
462	. .	1	Greenland.	. . . . .	Prof. Sars.	"
			Smithsonian Institution.			
1067	. .	1	Greenland.	. . . . .	University Museum, Copenhagen.	Alcoholic.

Astrophyton Caryi Lyman.

Astrophyton Caryi Lyman. Proceed. Boston Soc. Nat. Hist., VII. p. 424. 1860.

Special Marks. — Disk very distinctly granulated above, without spines. Finer granulation at the outer side of the mouth-angle, and along the edge of the genital slits.

Description of a Specimen. — Diameter of disk, 35mm.; from outer side of madreporic shield to outer corner of opposite mouth-slit, 16mm.; width of arm at base, from 9mm. to 13mm. Distance of the different forks from each other: —

First	fork to	second, ...	13mm.
Second	" "	third, ...	10 "
Third	" "	fourth, ...	22 "
Fourth	" "	fifth, ...	12 "
Fifth	" "	sixth, ...	14 "
Sixth	" "	seventh, ...	13 "
Seventh	" "	eighth, ...	9 "
Eighth	" "	ninth, ...	8 "
Ninth	" "	tenth, ...	8 "
Tenth	" "	eleventh, ...	6 "
Eleventh	" "	end, ...	1 "
			116mm.

Distance from outer side of madreporic shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 11 : 5. Madreporic shield very indistinct, oval, irregular, longer than broad. Teeth, tooth-papillæ, and mouth-papillæ stout, regular, conical, about twenty-four in number; those near the outer corners of the mouth-slits rather

smaller; most of them are clustered near the point of the mouth-angle. Arms covered above and on the sides with fine grains, which are grouped near the base of the arm in irregular vertical ridges; these ridges become more regular and distinct towards the end of the arm, and on the smaller branches take the form of a double vertical row of grains; along the middle line of the arm runs a very obscure narrow furrow, in which the grains are rather more scattered. Under side of the arms covered with a smooth skin, beset with fine, scattered, smooth grains; the joints are indicated by very faint cross lines. Interbrachial spaces above, and brachial spaces between the radial ribs, sprinkled with a few fine grains, like those of the arms, but coarser. The upper and lower surfaces are separated by a raised edge, which is slightly granulated. Radial ribs extending quite to the centre, closely beset with coarse, rounded grains; length to breadth, 17 : 5. Interbrachial spaces below covered with a very smooth skin, which is sprinkled with fine rounded grains. Genital slits bordered on the side next the interbrachial space by rows of fine grains. The granulation of the interbrachial space extends to the base of the mouth-angle. Arm-spines all hooked, microscopic, the lowest one largest, arranged in two vertical rows; they are abundant on the end twigs, but are not found on the main trunks within the seventh fork from the disk. Tentacle-scales three, sometimes four, and within the disk commonly two; spiniform, like the teeth, but blunter; they extend within the inner end of the interbrachial space. Color, in alcohol: above, light vandyke-brown; interbrachial spaces darker; below, under surface of arm nearly white; interbrachial spaces same as above.

A single specimen has been sent from San Francisco by Mr. T. G. Cary, to the Museum of Comparative Zoölogy.

Astrophyton Caryi is distinguished from *A. eucnemis*, which it resembles, by more regular granulation of the disk, by having blunter tentacle-scales, and by close rows of grains along the edge of the genital slits.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
445	. .	1	San Francisco, Cal.	. . . . .	T. G. Cary.	Alcoholic.

Astrophyton Agassizii Stimpson.

"The Basket Fish." Philosophical Transactions, IV. p. 1152. 1670. (J. Winthrop.)
Astrophyton scutatum; *scuto rotato?* Linck. De Stel. Mar., p. 65, Pl. XXIX. & XXX. 1733.
Euryale scutatum Gould (*non* De Blainville). Invertebrata of Mass., p. 345.
Astrophyton Agassizii Stimpson. Inverteb. Grand Manan, Smithson. Contrib., VI. p. 12. 1854.

Special Marks. — Radial ribs yellowish; interbrachial spaces brownish. Numerous short, conical spines irregularly disposed on the radial ribs. Interbrachial spaces above naked, or with very few blunt, short spines.

Description of a Specimen. — Diameter of disk, 73mm.; outer side of madreporic shield to outer corner of opposite mouth-slit, 24mm.; width of arm at base, 24mm.; length of arm, measured along the branches to the tip of the longest branch, 260mm. The distances *from one fork to the one beyond it* along the longest branch, were as follows (two branches from different arms are compared): —

From first	fork to	second, . . .	20mm. . . .	15mm.
" second	" "	third, ...	29 " . . .	32 "
" third	" "	fourth, . . .	41 " . . .	40 "
" fourth	" "	fifth, ...	28 " . . .	37 "
" fifth	" "	sixth, ...	40 " . . .	25 "
" sixth	" "	seventh, . . .	19 " . . .	34 "
" seventh	" "	eighth, . . .	18 " . . .	18 "
" eighth	" "	ninth, . . .	13 " . . .	19 "
" ninth	" "	tenth, . . .	11 " . . .	13 "
" tenth	" "	eleventh, . .	9 " . . .	11 "
" eleventh	" "	twelfth, . . .	7 " . . .	9 "
" twelfth	" "	end, ...	9 " . . .	7 "
			244mm.	260mm.

Distance from outer side of madreporic shield to inner points of mouth-papillæ, to that between outer corners of mouth-slits, 15 : 8. Mouth-papillæ, tooth-papillæ, and teeth, about twenty-four in all, cylindrical, tapering, thorn-like; mouth-papillæ forming a row of about ten, of which those near corners of mouth-slits are smallest; length of tooth-papillæ about 1.8mm. Madreporic shield broad heart-shape, with the point outward; irregular, indistinct; length to breadth, 4.2 : 6.2. Under surface of arms smooth and polished, with faint cross lines between the joints. Top and sides of arms nearly naked as far as the second fork of the arm, but beyond that granulated. Grains smooth, rounded; above, crowded; on the sides more scattered; as they approach the end of the arm they become more confined to vertical ridges, and more regular in arrangement; and at the tip of the arm

each joint has its double vertical row of large, close-set grains; along the upper surface runs a sunken line or furrow. Disk with interbrachial spaces below nearly naked, though bearing a few points not easy to see; above smooth, with a few scattered conical points; on the margin a raised edge, separating the upper and lower surfaces. Radial ribs large, prominent (particularly without), running nearly to the centre, and bearing a number of irregular grains, and low, conical points; length to breadth, 30 : 8; height (above upper surface of arm), 8mm. Genital slits with two to four large flat grains along the edge next the interbrachial space, and ending without in a blunt, conical point. Arm-spines microscopic, hooked; most numerous at the tips of the branches; found in numbers as far as the fifth fork from the disk, within which point they speedily disappear; at tips of branches arranged in two vertical rows, each spine standing on a rounded grain as a base. Tentacle-scales spiniform, resembling mouth-papillæ, standing in a close row; commonly three, sometimes four, near the mouth only two or one; they extend, though fewer and smaller, as far as the inner end of the interbrachial spaces. Color, in alcohol: arms and radial ribs light yellowish-brown (near raw sienna); disk and interbrachial spaces below dark purplish-brown. The living animal has the radial ribs yellow, and the interbrachial spaces brown (Stimpson).

Variations. — A smaller specimen, with a disk of 31mm., had arms with nine forks, of the following proportions: —

From	first	fork to	second, ...	13mm.
"	second	" "	third, ...	20 "
"	third	" "	fourth, ...	25 "
"	fourth	" "	fifth, ...	14 "
"	fifth	" "	sixth, ...	12 "
"	sixth	" "	seventh, ...	16 "
"	seventh	" "	eighth, ...	13 "
"	eighth	" "	ninth, ...	10 "
"	ninth	" "	end, ...	10 "
				133mm.

The radial ribs were more regularly covered with short, conical spines, than in the adult. In the interbrachial spaces above there were scarcely any grains, but below and on the edge of the disk there were numerous fine grains. The granulation of the arms was not so close as in the adult, and was more confined to vertical ridges. A very young specimen, with a disk of 2mm., had arms 4.3mm. long; there was but one fork in the arm, and this was at a distance of 2.2mm. from the disk. Except for this fork, the specimen might have almost been mistaken for the young of *Ophiopholis bellis*. The back of the disk was covered with about a dozen angular plates, which were separated by single rows of

large, rounded grains. The armature of the mouth consisted only of a single vertical row of conical teeth, whereof the lowest seemed sometimes to be split in two. The joints of the arms were constricted at the base, just as in a simple armed Ophiuran, and bore but a single row of small, hooked spines; the upper surface was clothed with large, round grains; the lower with a small, diamond-shaped under arm-plate, and side arm-plates, which met on the middle line. Two specimens, with disks of $3^{mm.}$ and $4^{mm.}$, had arms with two forks, and the disk pretty closely covered with grains, so that the plates were no longer distinct.

Astrophyton Agassizii has been obtained from the Gulf of Saint Lawrence (Captain Atwood), from Grand Manan Island (Stimpson), and from Cape Cod (Captain Atwood). It is distinguished readily from *A. eucnemis* and *A. Caryi* by the short, blunt, conical spines on the radial ribs.

The following letters of Governor John Winthrop deserve notice, as showing that this singular animal early attracted the attention of our forefathers. The descriptions themselves are quite worthy of a regularly educated naturalist: —

Philosophical Transactions, Vol. IV. Page 1152. 1670.

An Extract of a Letter written by John Winthrop, Esq., *Governor of Connecticut in New England, to the Publisher, concerning some Natural Curiosities of those Parts, especially a very strange and very curiously contrived Fish, sent for the Repository of the Royal Society.*

"There is, besides, in a large round Box, a strange kind of Fish, which was taken by a Fisherman when he was fishing for Codfish in that Sea which is without Massachuset Bay in N. England. It was living when it was taken, which was done, I think, by an hook. The name of it I know not, nor can I write more particularly of it, because I could not yet speak with the Fisherman who brought it from Sea. I have not seen the like. The Mouth is in the middle; and they say that all the arms you see round about were in motion when it was first taken.

"We omit the other particulars here, that we may reflect a little upon this elaborate piece of Nature. The Fish, which, since it is yet nameless, we may call Piscis Echino-Stellaris Visciformis; its Body (as was noted by M. Hook) resembling an Echinus or Egg-fish, the main Branches a Star, and the dividing of the branches the Plant Missel-toe. This Fish spreads itself from a Pentagonal Root, which incompasseth the Mouth (being in the middle) into 5 main Limbs or branches, each of which, just at issuing out from the Body, subdivides itself into two, and each of those 10 branches do again divide into two parts, making 20 lesser branches; Each of which again divide into 2 smaller branches, making in all 40. These again into 80, and those into 160; and they into 320; they into 640; into 1280; into 2560; into 5120; into 10240; into 20480; into 40960; into 81920; beyond which the further expanding of the Fish could not be certainly trac'd, though possibly each of those 81920 small sprouts or threds, in which the branches of this Fish seem'd to terminate, might, if it could have been examined when living, have been found to subdivide yet farther. The Branches between the Joynts were not equally of a length, though, for the most part, pretty near; but those Branches which were on that side of the

Joynt on which the preceding Joynt was placed were always about a 4th or 5th part longer than those on the other side. Every of these Branchings seemed to have, from the very mouth to the smallest twiggs or threds in which it ended, a double chain or rank of pores. The Body of the Fish was on the other side, and seems to have been protuberant, much like an Echinus (Egg-Fish or Button-Fish), and, like that, divided into 5 ribbs or ridges, and each of these seemed to be kept out by two small bony ribbs."

Vol. VI. Page 2221. 1671.

A further Accompt of the Stellar Fish formerly described in Numb. 57, p. 1153.

This Accompt was communicated by the same Gentleman that imparted the former, in a letter written from Boston, New England, Oct. 26, 1670, as followeth : —

" Since my former I found out the Fisherman who brought that Stellar fish from Sea. I asked all the questions I could think needful concerning it. I understood from him that he never saw nor heard of any but those few that were taken by himself, which were not above six or seven in all, and those at several times, not far from the Shoals of Nantucket (which is an Island upon the Coast of New England) when he was fishing for Cod and such like Marchantable fish. This Stellar Fish, when it was alive, and first pull'd out of the water, was like a basket, and had gathered itself round like a Wicker-basket, having taken fast hold upon that bait on the hook which he had sunk down to the bottom to catch other Fish, and having held that within the surrounding *brachia*, would not let it go, though drawn up into the Vessel; until, by lying a while on the Deck, it felt the want of its natural Element; and then voluntarily it extended itself into the flat, round form in which it appear'd when present'd to your view.

" What motion these fishes had in the water could not be known to him, for the water was deep, and they could not be seen in any other form than so gather'd up together to hold fast the bait. The only use that could be discerned of all that curious composure wherewith Nature had adorned it, seems to be to make it as a pursenet to catch some other fish, or any other thing fit for its food, and as a basket of store to keep some of it for future supply, or as a receptacle to preserve and defend the young ones of the same kind from fish of prey; if not to feed on them also (which appears probable the one or the other), for that sometimes there were found pieces of Mackerel within that concave. And he told me that once he caught one, which had within the hollow of its embracements a very small fish of the same kind, together with some piece or pieces of another fish, which was judged to be of a Mackerel. And that small one ('t is like) was kept either for its preservation, or for food to the greater; but, being alive, it seems most likely it was there lodged for safety, except it were accidentally drawn within the net, together with that piece of fish, upon which it might be then feeding.

" He told me further, that every one of those smallest parts had motion when it was alive, and a tenacious strength; but after it was dead, and extended to a flat round, it was so brittle that it could not be handled without breaking some parts of it; but by carefully laying of it to dry, it was thereby somewhat hardened.

" He added, that he had taken one of this kind of fish the latter end of this Summer, but had left it with a friend at another port where he had been. Meantime he promised to procure it for me when he should sail thither again, if it were not broken or defaced. I hope I shall engage him for the future to take better notice of what may be remarkable about it. Upon occasion I have inquired of divers other Fishermen and Mariners, but can meet with none other that ever have taken any of these fishes. This Fisherman could not tell me of any name it hath, and 't is in all likelihood yet nameless, being not commonly known as other Fish are. But, until a fitter *English* name be found for it, why may it not be called (in regard of what hath been before mentioned of it) a *Basket-Fish*, or a *Net-Fish*, or a *Purs-net-Fish?* "

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
446	. .	2	Euryale Bank.	. . . . .	Prof. Agassiz.	Alcoholic.
447	. .	3	Eastport, Me.	July, 1851.	Prof. Agassiz.	"
448	. .	1	Eastport, Me.	. . . . .	U. S. Treat.	"
449	. .	7	Gulf of St. Lawrence.	. . . . .	Capt. Atwood.	"
450	. .	7	Provincetown, Mass.	. . . . .	Capt. Atwood.	"
451	. .	4	Euryale Bank.	. . . . .	. . . . .	"
452	. .	4	Provincetown, Mass.	1852.	Capt. Atwood.	"
453	. .	2	Cape Cod.	. . . . .	. . . . .	"
454	. .	1	. . . . .	. . . . .	. . . . .	"
455	. .	2	Cape Cod.	. . . . .	. . . . .	Dried.
456	. .	1	. . . . .	. . . . .	. . . . .	"
457	. .	6	Cape Cod.	. . . . .	. . . . .	"
458	. .	1	Cape Cod.	. . . . .	Prof. Agassiz.	"
459	. .	1	. . . . .	. . . . .	. . . . .	"
438	. .	. .	Swampscott, Mass.	. . . . .	Essex Institute.	Alcoholic.
439	. .	. .	Cape Cod.	. . . . .	Aquarial Gardens.	"
440	. .	. .	Eastport, Me.	. . . . .	Mr. Beale.	"

Astrophyton Linckii Müll. & Trosch.

Asterias caput-medusæ? Linn. Fauna Suecica. 1761. No. 2115.
Astrophyton Linckii Müll. & Trosch. Syst. Asterid., p. 122.

The citations of Martens, Linck, and Knorr, as synonymes of this species, are all mistakes on the part of Müller and Troschel. It is impossible to say whether the *Asterias caput-medusæ* of Linnæus is this species or *A. Lamarckii.*

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
473	. .	1	North Europe.	. . . . .	Prof. Sars, 1852.	Dried.
474	. .	1	North Europe.	. . . . .	G. A. Cheney.	Alcoholic.

Astrophyton clavatum Lyman.

Proceed. Boston Soc. Nat. Hist., VIII. p. 85. 1861.

Special Marks. — Radial ribs closely beset with minute, thorny stumps or spines.

Description of a Specimen. — Diameter of disk, 30mm.; width of arm at first fork, 12mm.; length of arm, 231mm.

First	joint (within the disk) to	second, ...	8mm.
Second	"	" third, ...	12 "
Third	"	" fourth, ...	8 "
Fourth	"	" fifth, ...	9 "
Fifth	"	" sixth, ...	11 "
Sixth	"	" seventh, ...	11 "
Seventh	"	" eighth, ...	9 "
Eighth	"	" ninth, ...	10 "
Ninth	"	" tenth, ...	12 "
Tenth	"	" eleventh, ...	10 "
Eleventh	"	" twelfth, ...	11 "
Twelfth	"	" thirteenth, ...	11 "
Thirteenth	"	" fourteenth, ...	11 "
Fourteenth	"	" fifteenth, ...	7 "
Fifteenth	"	" sixteenth, ...	9 "
Sixteenth	"	" seventeenth, . . .	9 "
Seventeenth	"	" eighteenth, ...	9 "
Eighteenth	"	" nineteenth, ...	8 "
Nineteenth,	"	" twentieth, ...	8 "
Twentieth	"	" twenty-first, . . .	8 "
Twenty-first	"	" twenty-second, . . .	6 "
Twenty-second	"	" twenty-third, . . .	9 "
Twenty-third	"	" twenty-fourth, . . .	5 "
Twenty-fourth	"	" twenty-fifth, . . .	8 "
Twenty-fifth	"	" twenty-sixth, . . .	5 "
Twenty-sixth	"	" twenty-seventh, . .	5 "
Twenty-seventh	"	" twenty-eighth, . . .	5 "
Twenty-eighth	"	" end, ...	5 "
		Total length, ...	239mm.

Tooth-papillæ and teeth about thirteen, regular, cylindrical, tapering, sharp, the upper ones largest, the longest 1.5mm. Mouth-papillæ about four on each side, very small, somewhat irregular. Madreporic shield lying at the corner of the interbrachial space, broader than long, plainly made up of irregular, short, thickened tubes, soldered side by side. The space occupied by the tentacle-pores and the covered under arm-plates is sunken, forming a shallow trench, the joints being indicated by obscure cross lines. Beyond the disk the joints are marked by depressions between them, their outer and inner ends are thickened on the sides, making a series of very distinct double ridges along the sides of the arm. The under side of the arm, within and near the disk, is

covered by a close pavement of flattened grains; it is very distinct from the sides and upper surface, which are beset with fine rounded grains, and are separated from the lower surface by a sunken line. Along the upper surface of the arm runs a distinct median furrow. Radial ribs running quite to the centre of the disk, prominent, their outer ends cut abruptly off, making a concave scar; length to breadth, 17 : 4; they are closely beset with microscopic, thorny stumps or grains, some of which end in three or four distinct thorns. The same thorny grains are found, but smaller and more scattered, on the interbrachial spaces below, and a few also on the depressed parts of the upper surface of the disk. At the tips of the arms and on the smaller twigs there are, as usual, double vertical rows of grains, bearing hooks. Tentacle-scales one or two, small, and difficult to see, extending inward as far only as the fourth fork of the arm. Color, in alcohol: above, dark purplish-brown, varied with black; below, interbrachial spaces the same; under surface of arms much lighter.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
Museum of Comparative Zoölogy.						
475	. .	1	Zanzibar.	. . . . .	G. A. Cheney.	Alcoholic.

Astrophyton costosum Seba.

Astrophyton costosum Seba (*non* Linck). III. Pl. IX. Fig. 1, p. 16. 1758.
Euryale muricatum Lamk. An. s. Verteb., II. p. 538. 1816.
Astrophyton muricatum Agass. Mém. de la Soc. des Sciences Nat. Neuchatel, p. 12. 1839.
Astrophyton muricatum Müll. & Trosch. Syst. Asteriden, p. 122.
Astrophyton muricatum Lütken. Addit. ad Hist. Oph., p. 156.

Special Marks. — Disk purplish brown. Radial ribs sharply and much raised, bearing a few large fleshy spines, whose sides are often fluted.

Description of a Specimen. — Diameter of disk, 58$^{mm.}$; from outer side of madreporic shield to outer corner of opposite mouth-slit, 28$^{mm.}$; width of arm at base, 24$^{mm.}$. Length of arm and distances of its forks from each other, —

First	fork to	second, ...	8	mm.
Second	" "	third, ...	11	"
Third	" "	fourth, ...	14	"
Fourth	" "	fifth, ...	14	"
Fifth	" "	sixth, ...	14	"
Sixth	" "	seventh, ...	16	"
Seventh	" "	eighth, ...	16	"
Eighth	" "	ninth, ...	16	"
Ninth	" "	tenth, ...	16	"
Tenth	" "	eleventh, ...	19	"
Eleventh	" "	twelfth, ...	18	"
Twelfth	" "	thirteenth, ...	19	"
Thirteenth	" "	fourteenth, ...	20	"
Fourteenth	" "	fifteenth, ...	17	"
Fifteenth	" "	sixteenth, ...	17	"
Sixteenth	" "	seventeenth, ...	18	"
Seventeenth	" "	eighteenth, ...	21	"
Eighteenth	" "	nineteenth, ...	18	"
Nineteenth	" "	twentieth, ...	18	"
Twentieth	" "	twenty-first, ...	18	"
Twenty-first	" "	twenty-second, . . .	17	"
Twenty-second	" "	twenty-third, . . .	15	"
Twenty-third	" "	twenty-fourth, . . .	16	"
Twenty-fourth	" "	twenty-fifth, . . .	16	"
Twenty-fifth	" "	twenty-sixth, . . .	20	"
Twenty-sixth	" "	twenty-seventh, . .	13	"
Twenty-seventh	" "	twenty-eighth, . . .	12	"
Twenty-eighth	" "	twenty-ninth, . . .	12	"
Twenty-ninth	" "	thirtieth, ...	11	"
Thirtieth	" "	thirty-first, ...	10	"
Thirty-first	" "	thirty-second, . . .	8	"
Thirty-second,	" "	end, ...	11	"
		Total length, ...	489	mm.

Distance from outer side of madreporic shield to inner points of teeth, to that between outer corners of mouth-slits, 19 : 9. Teeth, tooth-papillæ, and mouth-papillæ sharp, conical, of different sizes; about eight, which occupy the place of teeth, are the largest, and attain the length of 2.8mm.; those which represent the inner mouth-papillæ are smallest; the outer mouth-papillæ extend quite to the outer corner of the mouth-slit. Madreporic shield irregular oval, broader than long, rather indistinct; placed at the inner angle of the interbrachial space. Arms covered above, below, and on the sides by a close, fine, smooth coat of microscopic grains. Below and on the sides the joints are plainly indicated by cross lines. On the upper side runs a distinct, longitudinal, sunken line; here also are scattered round spots, which, under the microscope, appear a little raised, and are made up of concentric rings of oblong grains. On the tip branches most of the grains are brought together to form a double vertical row of grains, which

bear the arm-spines, in the form of single microscopic hooks. These hooks seem only to be found on the fine twigs. Disk, above and below, covered with the same granular coat as the arms; above, also, are found the round spots in the interbrachial spaces. Radial ribs very large and prominent, ending without in a smooth, concave cicatrix; on their upper surface are numerous irregular spines, about 1.5$^{mm.}$ long, with deeply striated or fluted sides. Interbrachial spaces below very small, in consequence of the great breadth of the arms. Genital slits small, without margin of grains; length, 4.5$^{mm.}$. Tentacle-scales very fine, slender, spiniform; they are not found at all within the ninth fork of the arm on its main trunk; beyond this point there are one, two, three, and even four to each pore, the number being greatest on the smaller side branches; on the fine twigs, however, the number decreases, and the finest have them replaced by a single hook. Color, in alcohol: above, a fine purplish umber, with fine, indistinct spots of lighter; below, pale umber.

Variations. — Instead of being uniform, the upper surface is often spotted with darker. The teeth in younger specimens are often comparatively shorter and blunter, and the spines on the radial ribs are smooth, and not so numerous as in the adult. The young of this species have, on the basal part of the arm, a few short spines or large grains. The radial ribs are low and faintly marked, and bear at their outer end a large spine, like a horn; besides these there are only one or two small spines on the disk; the first fork of the arms is not at the margin of the disk, but a little way from it; on the under side of the arms the tentacle-scales, two in number, extend inward as far as the first fork. A small specimen had a disk of 10$^{mm.}$, and twelve forks to the arms, as follows: —

Disk		to	first fork, ...	3.0$^{mm.}$
First	fork	to	second, ...	4.0 "
Second	"	"	third, ...	6.0 "
Third	"	"	fourth, ...	6.0 "
Fourth	"	"	fifth, ...	4.5 "
Fifth	"	"	sixth, ...	4.0 "
Sixth	"	"	seventh, ...	6.0 "
Seventh	"	"	eighth, ...	4.5 "
Eighth	"	"	ninth, ...	4.5 "
Ninth	"	"	tenth, ...	4.5 "
Tenth	"	"	eleventh.	4.5 "
Eleventh	"	"	twelfth, ...	5.5 "
Twelfth	"	"	end, ...	3.0 "
				60.0$^{mm.}$

Astrophyton costosum has been found in the West Indies (Örsted, Riise, Suenson, Benzon), on the coast of Florida, at the Tortugas Isl-

ands, and at Charleston, S. C. It is fond of twining round *Gorgoniæ*, in which situation I have taken it on the mud flats of Key West, just below low-water-mark. When taken out of the water, it rolls up its many branches compactly. Its color, when alive, is similar to that of the alcoholic specimen, but is more brilliant, and the color of the back is more decidedly purplish.

It is very readily distinguished by the high radial ribs and their coarse spines, the long, evenly branching arms, the absence of tentacle-scales within the margin of the disk, the position of the madreporic shield at the inner angle of the lower interbrachial space.

The original "*Astrophyton costosum, costis conicis*," &c., of Linck, is not to be recognized as any species *now known*. Lamarck identified it with *A. arborescens*, the Mediterranean species, and was followed in the mistake by Agassiz. J. Müller considered it the same as his *A. muricatum*, and was equally wrong. Seba gives an excellent plate of the present species, and calls it *Astrophyton costosum*, which name I have kept, because it can be identified with certainty, and because it is strictly binomial.

In the Jardin des Plantes is the original of *Euryale costosum* of Lamarck (not Seba), brought by Maugé, in 1799, from the Antilles. There is a second specimen brought from Guadeloupe, in 1837, by Beaupertuis. What is most extraordinary, is, first, that this is neither the true *A. costosum* (*Euryale muricatum* Lamk.), nor *A. cœcilia*, nor *A. Krebsii*, the only species of the Antilles which the careful research of Dr. Lütken has brought to light; and, secondly, that this particular species bears so close a resemblance to *A. arborescens* as readily to pass for it. If it should really turn out to be a distinct species, it must receive a new name, as that of *costosum* is already taken.

LIST OF SPECIMENS.

Catalogue Number.	Original Number.	Number of Spec.	Locality.	When Collected.	Whence obtained.	Nature of Specimen.
			Museum of Comparative Zoölogy.			
464	. .	1	Florida.	. . . . .	Prof. Agassiz.	Alcoholic.
465	. .	1	Tortugas, Fla.	Apr. 2, 1857.	Capt. Woodbury.	"
466	. .	1	Tortugas, Fla.	Mar. 23, 1857.	J. E. Mills.	"
467	. .	2	Charleston, S. C.	. . . . .	Prof. Agassiz.	"
468	. .	1	Elliott's Key, Fla.	. . . . .	Lieut. T. A. Crane.	Dried.
469	. .	4	Florida.	. . . . .	Prof. Agassiz.	"
470	. .	1	Florida.	. . . . .	. . . . .	Alcoholic.
471	. .	2	Key West, Fla.	. . . . .	T. Lyman & C. Curtis.	"
442	. .	. .	Bahamas.	. . . . .	Mr. Sargent.	"
443	. .	. .	Key West, Fla.	. . . . .	Dr. Holder.	"
			Smithsonian Institution.			
1065	. .	3	Garden Key, Tortugas.	. . . . .	Capt. H. G. Wright.	Alcoholic.
1066	. .	2	Garden Key, Tortugas.	. . . . .	. . . . .	"

DESCRIPTION OF THE PLATES.

All the figures give a dorsal view, and are taken from the colored drawings in the collection of Professor AGASSIZ, made from living specimens by J. BURKHARDT and A. GARRETT.

PLATE I.

Figs. 1, 2. Hemipholis cordifera Lyman, $\frac{3}{2}$.
" 3. Hemipholis cordifera Lyman, $\frac{5}{2}$.
" 4, 5. Ophiopholis bellis Lyman, $\frac{2}{1}$.
" 6. Ophiopholis bellis Lyman, $\frac{5}{2}$.
" 7. Ophiura Holmesii Lyman, $\frac{3}{2}$.

PLATE II.

Figs. 1, 2. Ophiothrix angulata Ayres, about $\frac{2}{1}$.
" 3. Ophiothrix angulata Ayres, $\frac{3}{1}$.
" 4. Ophiolepis Garretti Lyman, $\frac{3}{1}$.
" 5. Ophiolepis elegans Lütken, $\frac{2}{1}$.
" 6. Ophiomyxa flaccida Lütken, $\frac{5}{2}$.

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ILLUSTRATED CATALOGUE

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY,

AT HARVARD COLLEGE.

Published by order of the Legislature of Massachusetts.

No. II.

NORTH AMERICAN ACALEPHÆ.

BY

ALEXANDER AGASSIZ.

CAMBRIDGE:
FOR SALE BY SEVER AND FRANCIS.
1865.

4 042
141

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Cambridge.

THE publication of the Illustrated Catalogue of the Museum of Comparative Zoölogy has been undertaken with a threefold object. In the first place, like the catalogues of most institutions of a similar character, it is intended to make the contents of our Museum generally known, and to facilitate our exchanges. In the second place, to be the medium of publication of the novelties received at the Museum, which require to be described and illustrated by diagrams or wood-cuts, or more elaborate plates. Finally, it is hoped that it may be the basis of a systematic revision of such natural groups of the animal kingdom as are most fully represented in our collections, and that it may, as far as possible, present to the scientific world the results of the investigations carried on in the Museum with a view of ascertaining the natural limits of the Faunæ at the present time and in past ages, and the genetic relations which may exist between the order of succession of organized beings upon the earth, their mode of growth, and their metamorphoses during their embryonic life, and the plan and complication of their structure in their adult condition.

The means for publishing this work have been most liberally granted by the Legislature, at a time when, in a less enlightened assembly, the material cares of the community would have engaged their exclusive attention.

L. AGASSIZ.

CAMBRIDGE, *March* 28, 1865.

PREFACE.

THE progress of our knowledge of the Class of Acalephs is at present so closely linked with every new observation which may be brought up in the history of the development of these animals, that it has been thought advisable to extend this Catalogue somewhat, and not make it simply an enumeration of the Acalephs in the collection of the Museum of Comparative Zoölogy at Cambridge. It has, however, been limited to the North American species; and even many of the Sertularians, Campanularians, and Tubularians in the collection are not described or mentioned here, because our information with regard to them is too scanty to be available. The mere enumeration, with short descriptions, of Hydroids, the development of which has not been fully traced, would probably only add, in the course of a few years, synonymes to some of the Medusæ, the adult stages of which may be well known, and would not advance in the least degree our acquaintance with the North American Acalephs. To make this Catalogue useful to American students, a few species described by other authors, of which there are no specimens in the Museum collection, are added, to facilitate further investigations. This is done with the less hesitation, as it is hoped that in a short time most of the species thus enumerated will have been figured in the diagrams of the Museum.

In the descriptions of the species, constant reference has been made to the bearing of the facts discussed, on the classification of Acalephs, and consequently much has been introduced which would be out of place in a descriptive catalogue. The wood-cuts, with the exception of a few borrowed from the Contributions to the Natural History of the United States by Professor Agassiz, have all been drawn on wood from nature by myself, and, though not highly finished, will yet generally give a better idea of the Acalephs, in this simple outline, than could have been done by a more finished wood-cut. Such an elaborate catalogue of Acalephs may seem somewhat out of place

here, but as special attention has been paid to them in the Museum at Cambridge, and as Professor Agassiz has introduced there a large number of diagrams, all copied from original drawings, to illustrate the structure and colors of animals which were too small or too perishable to be preserved in the ordinary way, these valuable materials have been extensively used in the preparation of this Catalogue, as forming actually a part of the collections exhibited in the showcases. The diagrams, as well as the authorities from which they are taken, are carefully enumerated below, after the specimens preserved in the collection.

For the facilities I have enjoyed in collecting the materials for this Catalogue I am mainly indebted to Mr. and Mrs. J. M. Forbes, to Professor A. D. Bache, Superintendent of the Coast Survey, to Mr. T. G. Cary, and to Professor Agassiz. I have also to thank, for specimens and valuable information, Professor Joseph Leidy, Dr. Fritz Müller of Desterro, Dr. W. Stimpson, and Professor H. J. Clark, who had already arranged the greater part of the Hydroids before the collection of Acalephs was placed in my charge. The Museum is also indebted for specimens to many other persons, whose names will be referred to in connection with the different species.

A. AGASSIZ.

CAMBRIDGE, MASS., *February*, 1865.

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NORTH AMERICAN ACALEPHÆ.

Order CTENOPHORÆ Esch.

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The affinities of the Ctenophoræ have become one of the most fertile topics of discussion among recent investigators. Vogt, following Quoy, removes them from the Acalephs altogether. Huxley places them in close proximity to Polyps. Clark has made a special class of them, equivalent to Echinoderms, while Milne Edwards and Agassiz, after a careful revision of the whole subject, have followed Cuvier and Eschscholtz, and retained them as an order of Acalephæ. These various views of the true relations of the Ctenophoræ are based upon very different grounds, and are urged with more or less force in accordance with the degree of importance attached by investigators to the details of structure upon which they separate the Ctenophoræ from the Acalephæ, and refer them to other classes of the Animal Kingdom; the apparent bilaterality so strongly developed in some of the families (as Cestum, Bolina, and Mertensia) being urged by Vogt as the principal ground for removing them from Acalephs, and associating them with the Mollusks; while Huxley places them with Polyps on the ground of the special structure of their digestive cavity; and Clark simply states his belief in their separation as a class, without furnishing us any proofs. We are able to throw new light on this question by a series of facts derived from their embryological development, hitherto unnoticed. As the observations of Dujardin on the development of Coryne gave us the key which led to the ultimate separation of the Hydroids from the Polyps, so I hope to be able to show that the development of the Ctenophoræ gives us a true insight into the disputed affinities of these animals.

Before the publication of the valuable observations of McCrady on the development of a species of Bolina, little was known of their embryology except the mere fact, derived from the few casual observations of Müller, Wright, Boeck, and Price, that the Ctenophoræ were probably all repro-

duced from eggs, and that at an early age they gave unmistakable signs of their parentage. McCrady's observations showed us how great were the changes of figure their young undergo before they assume the aspect of the parent. It has been my good fortune to trace these changes in several of our species of Ctenophoræ somewhat in detail, and I shall make use of the material thus afforded in discussing the position of these animals, as well as their pretended bilaterality, and, by comparing their mode of development with that of Polyps, Acalephs, and Echinoderms, endeavor to ascertain whether their association with them into one great branch of the Animal Kingdom is true to nature, or whether the affinities between the mode of execution in the plan of the members of the Cœlenterata are really of such a character as to justify their separation from the other Radiates as one great branch of the Animal Kingdom.

Let us first examine the character of the Cœlenterata and of the Radiata as they are understood. What is common to Polyps, Acalephs, and Echinoderms is a vertical axis, or rather an axis through which we can pass a plane at right angles, and in this plane draw two axes at right angles to each other. These axes, of course, are not equally prominent in Polyps, Acalephs, and Echinoderms; taking, for instance, the three axes as we find them in some of the Spatangoids, we have a vertical axis, a cœliac axis, and a diacœliac axis, the mouth and anus being placed in such a position with reference to the cœliac axis as to give us a right and left, an anterior and a posterior extremity. In the Acalephs, it is only among the Ctenophoræ that we can distinguish between the cœliac and diacœliac; but we have neither right nor left — no anterior or posterior — side; while in Polyps we can distinguish their axes with greater exactness than in the Hydroids and Discophoræ. We are so accustomed to impose our notions of symmetry on everything we meet, that it is difficult to divest ourselves of the idea that every animal has not necessarily a right and a left side, an anterior and a posterior extremity; we start with the idea that such relations must exist in all animals, however disguised, and under this impression we try to reconcile plans which are totally distinct. If, however, we admit the idea of different plans as the foundation of animal life, we must give up all attempt to find some passage from one to the other. Animals the equation of which could be represented by that of a sphere, or by that of two parallel planes, or of a series of cylinders, or of two parallel cylinders, can never pass from one to the other; the equation of a sphere cannot be transformed into that of a plane, nor into a cylinder; the equations representing each of these figures include, it is true, all the possible spheres or all the possible cylinders which may be constructed by changing the values of the variables, but can never be transformed one into the other. The infinite variety of forms, and

apparently aberrant types, constantly met with among animals, has been the main cause of our difficulty in referring them to their proper plan. It is not always an easy matter to reduce an equation to its simplest form, and find out what it is; it may be concealed by coefficients which will disappear only after repeated operations, and then only enable us to determine of what degree the equation is. These coefficients in an equation may be compared to the modifications of those parts which appear to affect the mode of execution in animals; and it may not always be an easy matter nor a possible one, in the present state of our knowledge, to solve these organic equations. The history of Science is full of examples of this kind; and we may have to discover new methods in Natural History, as well as in Mathematics, before we can proceed with our eliminations, or arrive at a solution. Thus the plan of radiation may be so carried out, by a modification of some of the parts, as to appear at first sight to be bilateral; but analyze these modifications carefully, and beneath them all can be traced the plan of radiation, hidden only by external features of bilaterality. Such is eminently the case in the larvæ of Echinoderms, and to a less degree in the imitations of Echinoderm larvæ, the Ctenophoræ. Bilaterality seems at first sight to be the plan upon which these animals are built; but an elimination of the deceptive coefficients will show the plan of radiation underlying this apparent bilaterality.

The figures here given of very young Ctenophoræ show no indication of this bilaterality, at least no more than can be traced in any four-rayed jelly-fish. The tubes are as yet all of equal size, no prominence is given to one side over the other, and the only hint of bilaterality is the early distinction of the longitudinal and of the transverse axis by the position of the tentacles. No lateral appendages developing into immense lobes, as in the adults, can as yet be detected. The characteristic feature of the eggs of the Ctenophoræ is the great diameter of the envelope compared to the yolk, which is hardly more than one third the diameter of the egg. The whole yolk is transformed by segmentation into the embryo; this at an early period assumes a very slightly pear-shaped form, and is moved by means of a few pairs of large locomotive combs, equalling in length the diameter of the embryos. This is the first indication we have that the embryo is a Ctenophore; and the early stages are marked by the constant and violent flapping of the combs, arranged in four bunches near the abactinal pole, immediately at the base of the large eye, also disproportionately large in the young, containing but few granules, and seeming almost like a glass ball fastened to the top of this active embryo. During this stage the young Ctenophore is moving about somewhat slowly within the envelope of the egg. With increasing age the locomotive flappers descend somewhat along the spheromeres, and we find at the opposite

extremity from the eye the first trace of a small cavity (the digestive cavity of the adult), which increases in size till it becomes spherical. At about this time there is found, between the four clusters of the locomotive flappers, a second cavity, which has at first no connection whatever with the digestive cavity, and develops independently of it. This second formed cavity, now a large rectangular bag, slightly lobed between each of the four clusters of locomotive flappers, is the chymiferous cavity, from which the funnel and the chymiferous tubes take their origin in somewhat older stages. With advancing age the walls of the two cavities become more circumscribed, and at the same time more clearly defined, approaching each other constantly, until finally they open into each other. The digestive cavity and the chymiferous tubes diminish in diameter, becoming more circumscribed, and losing little by little the character of broad pouches for that of narrow tubes, extending through the gelatinous mass. The locomotive flappers extend with the chymiferous tubes along each one of the four pouches, which have given rise to two chymiferous tubes, one long and one short one, developing independently. This difference is barely perceptible in the adult Pleurobrachia; it is well marked in Mertensia, still better in Idyia, quite prominent in Lesueuria, and takes its greatest development in Bolina, where adjoining tubes anastomose after almost endless windings through the large lobes formed by the lateral projections of the gelatinous mass. The cause of the predominence of some of the spheromeres over the others, is the unequal development of these two sets of tubes, which may or may not extend into lobes, thus giving to the Ctenophoræ the appearance of bilateral animals. But examine this same development in another class of Radiates, among the Echinoderms, in the Spatangoids, for instance, where the odd ambulacrum is the one which takes the least development, when the other four are more equally developed, and no one will for that reason forget their radiate character, and call them strictly bilateral animals.

We can thus distinguish, among Spatangoids, an anterior and a posterior extremity, a right and a left side. In Ctenophoræ, owing to the peculiar manner in which the difference between the chymiferous tubes is developed, we are enabled to distinguish simply two diameters, but not an anterior and a posterior extremity, or a right and a left side; it seems, therefore, scarcely logical to call these animals bilateral, when in reality they show less sign of bilaterality than the Spatangoids, which no one, except Huxley, seems to doubt belong to Radiates.* The axes we can thus distinguish among the Ctenophoræ by the unequal development of the chymiferous tubes, would not enable us to decide whether the long tubes of the different genera were the same tubes developed more fully in the different species. For instance, we should at first

* See analysis of this view in Agassiz's Contributions, Vol. V. p. 60, by A. Agassiz.

sight suppose the long tubes of Pleurobrachia, of Mertensia, of Idyia, of Bolina, of Lesueuria, to be homologous, but such is not really the case; and the only means we have of determining this is the plane passing through the tentacles, enabling us to ascertain whether the longitudinal axis is in the trend, or at right angles to that plane. We shall soon see that in Pleurobrachia and Mertensia the plane, including the tentacles, passes through the long axis, while in Bolina and Lesueuria it passes through the short axis; that the long tubes are on each side of the tentacles, and consequently that the long tubes of Mertensia and the long tubes of Bolina are not homologous; but what corresponds strictly to the long tubes of Pleurobrachia and Mertensia are the short tubes placed on each side of the tentacular system. The lateral tubes invariably in the plane of the tentacular system give us the means of determining to which of these two classes Idyia belongs, and we find that its longitudinal axis corresponds with that of Bolina, the lateral tubes being in the shorter axis, as in the last-named genus, while in Pleurobrachia, as in Mertensia, they are in the longer axis. Such is the origin of the characters which give to some members of the Ctenophoræ their remarkable bilateral appearance. It is simply a modification of what is perfectly familiar to us among Echinoderms, and especially among the Spatangoids; but owing to the bilateral character of their development, the Ctenophoræ make us lose sight entirely of the original radiate plan upon which these animals are built. Viewing, however, this differentiation of the axis in all its stages, as we find it in Pleurobrachia, in Idyia, in Mertensia, in Lesueuria, in Bolina, we constantly keep before our eyes the original formula from which the other members are derived.

Examined in the light of prophetic beings, the bilaterality of the Acalephs is but another of those wonderful links which unite in one great whole the different members of the Animal Kingdom. As the Polyps are the prophetic representatives of the Acalephs in their embryonic condition, the Hydroid state, so must we look at the Ctenophoræ as the prophetic type of those still more wonderful beings, the Echinoderm larvæ, in which bilateral symmetry is carried to such an extent that even the great mind of a Müller is led to consider them as exhibiting a direct passage from a bilateral to a radiate plan of structure. In the bilateral symmetry of the Ctenophoræ we are constantly reminded of the general appearance of Echinoderm larvæ, in which the radiate structure should still be so far apparent as not to be concealed by the bilateral symmetry.

Looking at the Ctenophoræ as prophetic animals, we are able to understand the separation of the digestive cavity into two distinct parts. It is only what we find more fully developed in the Echinoderm larvæ; the separation of a sort of alimentary canal, in Ctenophoræ,

from the rest of the digestive apparatus, exactly corresponding to what exists in Echinoderm larvæ. The connection between the water system and the digestive system is likewise precisely similar to that of Echinoderms in their larval state; for although in the adult Star-fish, or Sea-urchin, or Ophiuran, there is no apparent connection between the ambulacral and the digestive system, yet in the young larvæ we can see that this connection exists, the water system being formed by diverticula from the digestive cavity; while the injections of Professor Agassiz have proved the existence, in the adult, of a similar connection in Echinarachnius, in Mellita, and in Clypeaster.

It was only after the embryos of Echinoderms had been compared with Ctenophoræ that undoubted evidence of their identity of plan was obtained. The embryological development of Ctenophoræ leaves no doubt as to the Acalephian character of the order. It remains only for us to see whether the Ctenophoræ form a group of equal value with the rest of the Acalephs, or stand simply as an equivalent of the other two orders, the Discophoræ and the Hydroids. The careful examination lately made of many genera of which we had no definite knowledge before, as well as their embryology, has now left it difficult to decide whether the Discophoræ and Hydroids are independent orders, or whether the distinction established between the Discophoræ and Hydroids is merely a subordinal division in a great order, including these two. If so, this order might be called the Medusidæ, in opposition to the Ctenophoræ, which are an order perfectly and accurately circumscribed; the presence of locomotive flappers being as characteristic for the Ctenophoræ, and as constant a feature of Ctenophoræ among Acalephæ, as feathers are for the class of Birds among Vertebrates. These flappers exist almost from the earliest embryonic stages, and thus far not a single exception is known to the rule. Fritz Müller and Agassiz have shown that it is hardly natural to associate the Charibdeidæ and Æginidæ with the Hydroids, and the latter has proposed to unite them with Discophoræ, while the former would make a separate order of them. This seems hardly justifiable, as there are as many reasons — their marginal appendages, genital organs, &c. — for uniting them with Discophoræ, as for leaving them with the Hydroids, — the shape of the bell, the great development of the veil. If, in addition, we take into account what we have observed in the Trachynemidæ, it will be seen that we can no longer draw the line between the Discophoræ and Hydroids as distinctly as before; while the creation of a third group equivalent to these two, to contain the families in dispute, does not bring us any nearer to the solution of the problem. A more accurate knowledge of the tropical forms will go far to settle this point; and in the mean while, with this explanation, I will place temporarily (until further information can be gained) the Æginidæ and the Trachynemidæ among

the Discophoræ, with the full expectation that future researches will give us better reasons than we have at present for abandoning, as contrary to nature, two orders which have thus far been almost universally acknowledged by all investigators of Medusæ. If the Discophoræ are to be united with the Hydroids, we shall have to divide the Acalephs into two orders, Ctenophoræ and Medusidæ; the different suborders of the latter division including all the suborders of the Discophoræ of Eschscholtz, and those of the Hydroids as limited by Professor Agassiz.

The remarkable changes of form the Ctenophoræ undergo until they attain their adult state, will necessitate at no very distant time a complete revision of the Ctenophoræ, as soon as the embryology of a sufficient number of families has become well known. What is now especially wanting is an embryology of Cestum, which would give us, with what has been shown here of the embryology of the three other suborders of Ctenophoræ, a standard for an embryological classification of the Ctenophoræ. We can already see that many of the genera of Eschscholtz (*Medea* and *Pandora*), as has already been suggested by Professor Agassiz and by McCrady, are only embryonic stages; all such species as the *Cydippe quadricostata* of Sars (*Bolina norvegica*), the *Cydippe brevicostata* of Will (*Chiaja multicornis* M. Edw.), and the *Sicyosoma rutilum* of Gegenbaur, are undoubtedly undeveloped stages of some of the well-known Ctenophoræ of the Northern Ocean, the Adriatic, and the Mediterranean. From what has been shown of the transformations of *Bolina alata*, I should even be inclined to consider the *Cydippe hormiphora* of Gegenbaur as one of the stages of growth of *Euramphæa vexilligera* Gegenb. It seems to me that there is between these two species the same relation which exists between some of the stages here figured of *Bolina alata*. The material at my command is too imperfect to attempt anything more definite than the few hints here thrown out for more fortunate observers.

Professor Agassiz, in his third volume of the Contributions, intended to give an embryology of some of our species of Ctenophoræ. He made many observations previous to 1856, which, however, were never noted down; only a couple of sketches of a young Pleurobrachia were drawn by Mr. Sonrel; and during the subsequent summers other and more pressing work compelled him to forego his intentions. The observations here presented, in the descriptions of our common species, were made independently during the summers of 1860–63.

Suborder LOBATÆ Esch.

Lobatæ Esch. Isis., p. 741. 1825.
Lobatæ Agass. Cont. Nat. Hist. U. S., III. p. 289. 1860.
Mnemiidæ Esch. Syst. d. Acalephen, p. 29. 1829.

In the Lobatæ we find that the diameter passing through the tentacular apparatus is invariably the smaller, while the compression of the spherosome is in the plane at right angles to it. This is reversed in the Saccatæ. The spheromeres at the extremity of the longer transverse axis, the cœliac axis, develop into lobes.

Family BOLINIDÆ Agassiz.

Bolinidæ Agass. Cont. Nat. Hist. U. S., III. pp. 200, 289. 1860.

The family of Bolinidæ has here a somewhat different circumscription from that ascribed to it by Professor Agassiz in his "Contributions." The genus Lesueuria, of which no species was known on our coast in 1860, has been removed from the Mnemiidæ to the Bolinidæ. It is evident from the description hereafter given of Lesueuria, that this genus is only a Bolina with diminutive lateral lobes. The genus Mnemiopsis also is shown to belong to the Bolinidæ, and not the Mnemidæ.

BOLINA Mert.

Bolina Mert. Mém. Acad. St. Petersb., II. p. 513. 1833.
Bolina Agass. Mem. Am. Acad., IV. p. 349. 1849.
Bolina Agass. Cont. Nat. Hist. U. S., III. p. 249. 1860.
Mnemia Sars (*non* Esch.). Beskriv., p. 32. 1835.
Alcinoe Less. (*non* Rang). Zooph. Acal., p. 88. 1843.
Anais Less. Zooph. Acal., p. 101. 1843.

Bolina septentrionalis Mert.

Bolina septentrionalis Mert. (*non* Agass.). Acad. St. Petersb., p. 515, Pl. VII. 1833.
Bolina septentrionalis Less. Zooph. Acal., p. 83. 1843.

Off Matthæi Island, Behring's Straits (Mertens).

Bolina alata Agass.

Bolina alata Agass. Mem. Am. Acad., Vol. IV. Pt. 2, p. 349, Pls. 6, 7, 8. 1849.
Bolina alata Agass. Contrib. Nat. Hist. U. S., Vol. III. pp. 249, 289.
Alcynöe vermicularis Gould (*non* Rang). Inverteb. of Mass., p. 349. 1841.
Bolina alata Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Bolina alata Packd. A List of Animals dredged near Caribou Island, Can. Nat. & Geol. 1863.

It is quite remarkable that there should be no mention made by Fabricius of a single Ctenophore which may be identified with any species of the genus Bolina. There is hardly a more common Medusa than the *Bolina alata* of our coast; and the occurrence of so many of our species of Ctenophoræ on the coast of Greenland makes the absence of Bolina the more striking, and quite interesting in a geographical point of view, as we should thus have among Acalephs a case of geographical distribution analogous to that of Echinarachnius, which does not extend farther north than Labrador.

To the description of the adult given by Professor Agassiz I have nothing of importance to add, with the exception that the chymiferous tubes which run along the edge of the lateral lobes, when seen from the narrow side, should unite, and thus complete the circuit (Fig. 16), instead of stopping short at a little distance apart, as they have been represented by him. This connection takes place at an early period of the development. (See Fig. 8.)

The compression of the spherosome of Bolina and of Pleurobrachia is in different planes, otherwise it would be exceedingly difficult to distinguish a very young Pleurobrachia from a young Bolina. In the young Bolina, as has been shown already by McCrady, we find long tentacles; so that the younger stages of this Medusa are so unlike the adult, that it would be the most natural error to commit, to consider it the young of Pleurobrachia. The accompanying figures (1–3) are taken immediately after the escape of the young from the egg. It will be noticed, when compared to Pleurobrachia, that besides the position of the tentacular organ, the outline of the spherosome is somewhat different, and that the ambulacra are quite narrow. The digestive cavity also fills a comparatively small space. (Fig. 2.) The extreme tenuity of the tubes soon becomes a character by which the young Bolina is at once distinguished from the young Pleurobrachia, as well as its ellipsoid shape, which greatly increases

Fig. 1.

In all the young Ctenophoræ the following lettering has been adopted: *d*, digestive cavity; *a*, anal rosette; *t*, tentacle; *c*, long ambulacral tube (longitudinal ambulacra); *c'*, short ambulacral tube (lateral ambulacra); *e*, eye speck; *f*, funnel; *o*, ambulacral cavity; *l*, lateral tubes. *c'* is the longest tube at first, and *c* the shorter; *n*, lobes of spherosome; the names are taken from the adult.

Fig. 1. Young Bolina, seen from the narrow side.

with age. (Fig. 4, which is Fig. 6 seen from abactinal side.) We soon perceive in the young of this species changes of shape similar to those to be described in Idyia and Pleurobrachia: the outline becomes more elongated; the lateral tubes, at first simple diverticula from the main

Fig. 2.

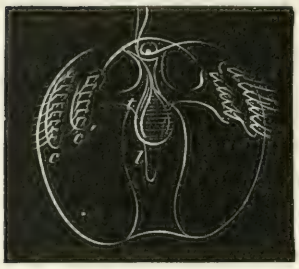


Fig. 3.

Fig. 4.

Fig. 5.

ambulacral tubes (*l*, Fig. 5), extend to the level of the opening of the mouth (Fig. 6). We can also trace a difference in the rapidity of growth of the ambulacral tubes, but, contrary to what we find in other genera, we observe the tentacular ambulacra are the most rapid in their growth. When they reach the bottom of the spherosome, they bend towards each other (Fig. 7), and finally join (Fig. 8), but have at present no connection with the lateral tubes near the mouth. It will be noticed by the figure (*n*, Fig. 8) that that part of the spherosome which contains the junction of the two lateral ambulacra (Figs. 9, *n*, 10), has a tendency to expand beyond the level of the mouth; this is the first appearance of the lobes of the adult Bolina. This part of the spherosome increases rapidly in dimensions, and we have a minute Ctenophore with well-marked lobes, like a Bolina, and highly developed tentacles, like a Pleurobrachia (Fig. 11). Still greater changes are yet to take place; we soon perceive that

Fig. 6.

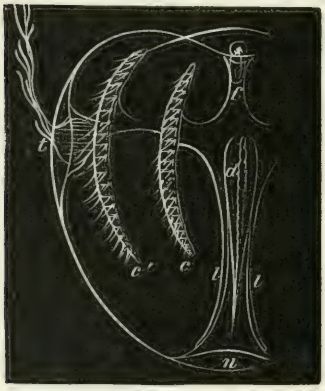


Fig. 7.

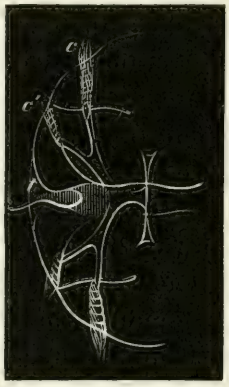


Fig. 2. Bolina in state of Fig. 1, seen from the broad side.
Fig. 3. Somewhat younger than Fig. 1, seen from the abactinal pole.
Fig. 4. Young Bolina, seen from the abactinal side, somewhat older than previous figures.
Fig. 5. Formation of lateral tubes in young Bolina.
Fig. 6. Bolina in which lobes begin to appear, seen from narrow side, same state as Fig. 4.
Fig. 7. Somewhat more advanced than Fig. 6, the tube *c'* not yet having formed the circuit; seen from the actinal side.

the long ambulacra do not remain regularly arched, but bend towards the vertical axis (Figs. 12, 13); this bend is soon changed into a loop, which passes through a corresponding protuberance of the spherosome. This becomes the auricle, from the angle of which (Fig. 14) we also perceive a branch of the chymiferous tube, which soon pushes its way through the gelatinous mass, and forms a junction with the lateral tubes, exactly as we shall find it to be the case with Idyia. In the mean time the other ambulacra have been increasing in length, and we find that they reach almost to the lower end of the lobe; when there, they make a sharp angle, turn upward, and form thus the beginning (Figs. 12, 13) of the complicated system of windings which we find in the lobes of the adult Bolina. During the later stages of growth the tentacular apparatus has been shifting its position, the opening coming nearer and nearer to the level of the mouth; the tentacular bulb lengthening in proportion, and finally appearing like a long, narrow rod, with a slight swelling at the extremity, from which the remnants of the threads of the tentacles are suspended. The only changes necessary to make this young an adult Bolina, are changes of quantity. The apparent difference in the mode of growth of the

Fig. 8.

Fig. 9.

Fig. 10.

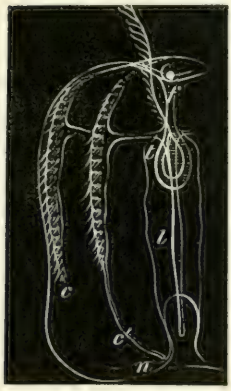


Fig. 11.

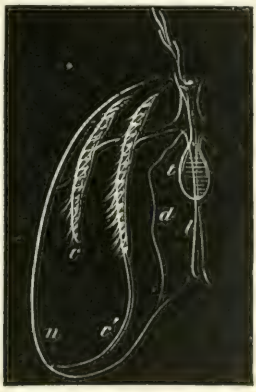


Fig. 12.

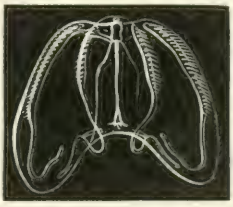


Fig. 13.

Fig. 8. The tentacular ambulacra have united, and the lobes (*n*) project well beyond the opening of the mouth.

Fig. 9. About in the condition of Fig. 2, seen from the broad side.

Fig. 10. Somewhat younger than Fig. 8, seen from the broad side.

Fig. 11. Fig. 8, seen from the broad side.

Fig. 12. Bolina with first appearance of the auricles, seen from the broad side.

Fig. 13. Bolina of stage of Fig. 12, seen from the narrow side.

lateral and longitudinal tubes is entirely done away with in subsequent changes, as we find that the short ambulacra are the lateral ambulacra, though at first they are more rapid in their growth, but are afterwards outstripped by the rapid increase in length of the longitudinal tubes; but it must be remembered that, in this genus, the flattening of the spherosome takes place in different planes from Idyia and Pleurobrachia. The young Bolina has now attained a condition in which it will be very easy to recognize the different parts of the adult, if compared in homologous positions. Fig. 15 is an adult seen from the broad side, corresponding to Fig. 12; Fig. 16 is an adult seen from the narrow side, corresponding to Fig.

Fig. 14.

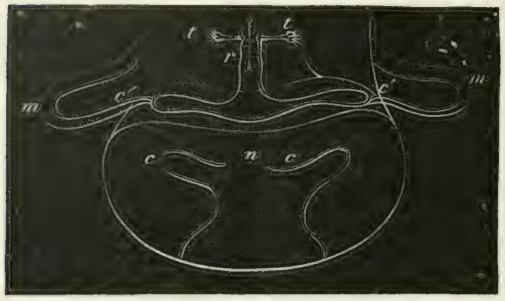


Fig. 15.

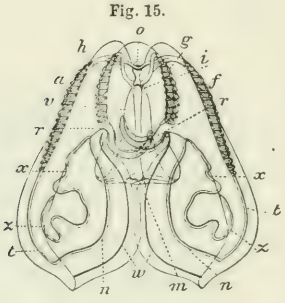


Fig. 17.

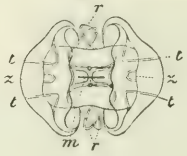


Fig. 18.

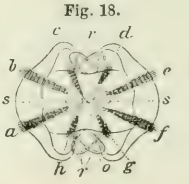
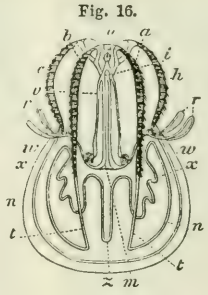


Fig. 16.



13; Fig. 17 is an adult Bolina, seen from the actinal side, corresponding to Fig. 14; and in Fig. 18 we have the adult seen from the abactinal pole.

Coast of New England, and northward to the Bay of Fundy (Agassiz).

Museum diagrams Nos. 1, 2, after L. Agassiz.

Fig. 14. Fig. 13 seen from the actinal pole, and more magnified. *r*, circular tube; *m*, auricles.

Fig. 15. Adult Bolina seen from the broad side. *a*, *f*, longitudinal ambulacra; *g*, *h*, lateral ambulacra; *o*, eye-speck; *i*–*m*, digestive cavity; *i*–*o*, funnel; *v*, lateral tube leading to tentacular apparatus just on level of mouth, *m*; *r*, *r*, auricles; *t*, *t*, prolongation of the longitudinal ambulacra; *n*, *n*, same tubes turning upwards, bending down at *x*, *x*; *z*, *z*, point of junction of tubes from opposite sides; *w*, prolongation of tubes from the lateral ambulacra. About half natural size.

Fig. 16. Fig. 15 seen from the narrow side. *a*, *b*, longitudinal ambulacra; *c*, *h*, lateral ambulacra; other letters, as in Fig. 15.

Fig. 17. Bolina seen from the actinal pole; lettering as above.

Fig. 18. Bolina seen from the abactinal pole. *a*, *b*, *e*, *f*, longitudinal ambulacra; *c*, *d*, *g*, *h*, lateral ambulacra; *s*, *s*, circumscribed area; other letters, as above.

Bolina vitrea Agass.

Bolina vitrea Agass. Contrib. Nat. Hist. U. S., Vol. III. pp. 269, 289, Fig. 93. 1860.
? Bolina littoralis McCr. On the Development of two Species of Ctenophoræ, 1857; Proc. Elliot Soc. N. H., p. 1. 1858.

The *Bolina littoralis* McCr. is probably either this species, or one of our species of Mnemiopsis; but not having the means to determine this point, a figure (Fig. 19) of the *Bolina vitrea* Agass. is added here, to serve as a basis for its identification hereafter.

Reef of Florida (Agassiz); Charleston (McCrady).

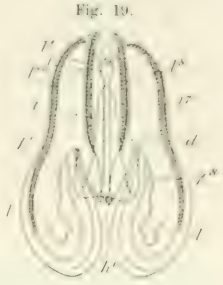


Fig. 19.

Bolina microptera A. Agass.

Bolina septentrionalis Agass. (*non* Mertens). Cont. Nat. Hist. U. S., III. p. 289. 1860.

The discovery of several species of Bolinidæ on the eastern coast of North America, belonging to different genera, which had all been confounded together, has induced me to examine anew the descriptions and drawings of the species of Bolina observed on the northwest coast. I have become satisfied that the species of Bolina here noticed is not the *B. septentrionalis* of Mertens, but differs specifically from it. It is quite elongated; the lateral lobes are very short, with complicated windings of the long ambulacral tubes. This species resembles in outline more the *Bolina vitrea* Agass. than any other. It has, like it, a long digestive cavity, but differs from it in the proportions of the lateral lobes, and the complexity of the windings of the long ambulacra. It is, like the *B. vitrea*, perfectly transparent and nearly colorless, of a slight bluish tinge; the polar diameter measures about two inches. Found in June, in the Straits of Rosario, Washington Territory.

Gulf of Georgia, W. T. (A. Agassiz).

MNEMIOPSIS Agass.

Mnemiopsis Agass. Cont. Nat. Hist. U. S., III. pp. 269, 290. 1860.

The genus Mnemiopsis is remarkable among the Bolinidæ for the peculiar structure of the tentacular apparatus, which sends a branch along a deep furrow, protected by a lappet, to the base of the auricles.

Fig. 19. Bolina vitrea seen from the broad side. l^2, l^7, long ambulacra; l^1, l^8, short ambulacra; *f*, funnel; *d*, digestive cavity; *t*, tentacular tube; χ^1, χ^8, auricles; *l*, *l*, anterior and posterior lobes; *h'*, tentacle.

Mnemiopsis Gardeni Agass.

Mnemiopsis Gardeni Agass. Cont. Nat. Hist. U. S., III. pp. 269, 290, Figs. 95, 96. 1860.

Fig. 20.

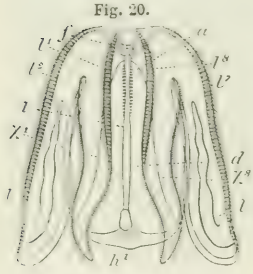
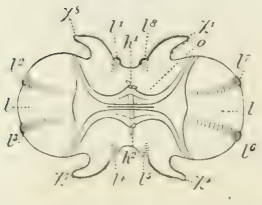


Fig. 21.



The accompanying figures (Figs. 20, 21) of *Mnemiopsis Gardeni* Agass. are here introduced to show how striking are the differences in the proportions of the two Medusæ of this genus found upon our coast. The great length of the digestive cavity, together with the size of the auricles and lobes, enable us at once to distinguish this species from its ally, the *Mnemiopsis Leidyi* A. Agass. The genus Mnemiopsis had been placed by Professor Agassiz among the Mnemiidæ, on account of the deep furrow separating the anterior and posterior lobes from the lateral spheromeres. The differences of form based upon this structural feature, which are in such striking contrast in Bolina and *Mnemiopsis Gardeni*, are far from being marked when we compare *Bolina alata* and *Mnemiopsis Leidyi*.

Charleston, S. C. (L. Agassiz).

Mnemiopsis Leidyi A. Agass.

This Medusa would readily be mistaken for a true Bolina, at first glance; a closer examination, however, will show that, notwithstanding the short digestive cavity which reminds us of Bolina, we have the deep furrow separating the anterior and posterior lobes from the lateral spheromeres. The long ambulacra are covered with locomotive flappers to the actinal margin, and we have long auricles, showing that this is a Mnemiopsis, with longer anterior and posterior lobes than we have in the *Mnemiopsis Gardeni* Agass.

This species grows very large, specimens measuring six and even eight inches in length are frequently found. Like the other Ctenophoræ of our coast, it is gregarious; thousands being collected together basking in the sun. It is exceedingly phosphorescent; and when passing through shoals of these Medusæ, varying in size from a pin's head to several inches in length, the whole water becomes so brilliantly luminous that an oar dipped in the water up to the

Fig. 20. Mnemiopsis Gardeni seen from the broad side. *a*, folds of digestive cavity. Lettering of Figs. 20 and 21 same as Fig. 19.

Fig. 21. Fig. 20 seen from the actinal pole. *o*, mouth; l^4, l^5, lateral ambulacra; χ^4, χ^5, auricles; l^2, l^3, l^6, l^7, anterior and posterior ambulacra.

handle can plainly be seen, on dark nights, by the light produced by this illumination. The seat of the phosphorescence is confined to the rows of locomotive flappers, and so exceedingly sensitive are they that the slightest shock to the jar in which these Medusæ are kept is sufficient to make them plainly visible by the light emitted from the eight phosphorescent ambulacra. This species is long, almost ellipsoidal, when at rest. (Fig. 22.) The auricles extend about one third their length beyond the oral aperture (*o*, Fig. 22), taking their origin on a level with the eye-speck (*a*, Fig. 22). The prolongation of the chymiferous tubes, and their manner of anastomosing, is exceedingly simple; we find nothing of the complicated bends and turns (Fig. 23)

Fig. 22.

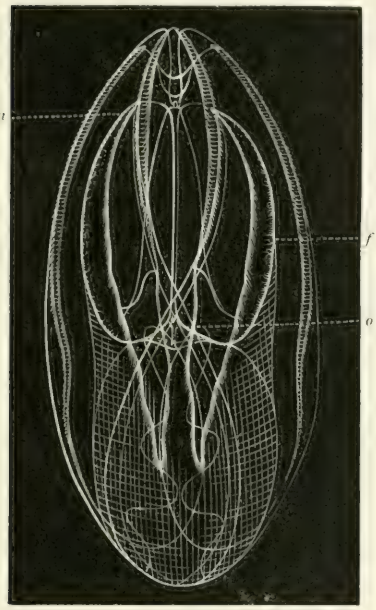
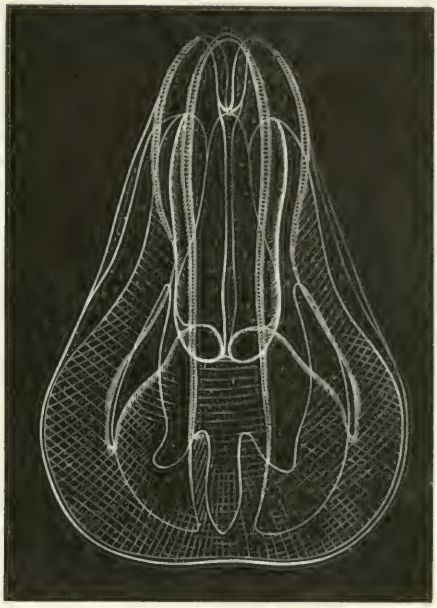


Fig. 23.



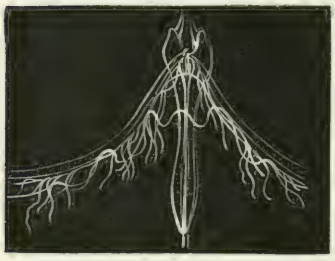
of the same tubes which we have in *Bolina alata* (Fig. 16). *Bolina alata* ranks among the most perishable of all our Medusæ; but this species seems to be very hardy, as I kept one large specimen alive for three weeks, during the whole of my stay at Naushon. This specimen also laid eggs, which were developed into small Mnemiopsidæ, after passing through stages in which it was almost impossible to say whether the Medusa was a young Pleurobrachia or not. As is the case in Bolina, the long tentacles, the globular outline of the young, resembled so closely the young of Pleurobrachia, which were developing at the same time in another bottle, that frequently I would be unable, after leaving them for some time, to decide at once to which

Fig. 22. Mnemiopsis Leidyi seen from the broad side. *o*, starting-point of branch of tentacular apparatus extending along the furrow, *f*, to *a*, the base of the auricles.

Fig. 23. The same as Fig. 22, seen from the narrow side.

species the young belonged, as the difference between the diameters is far less marked than in Bolina. As they advance in size, the lobes become developed, the tentacles disappear, and they can be readily distinguished. The development goes on in the envelope for a week or ten days after the eggs are laid, the young Medusa not breaking through the outer membrane before it is well advanced, and capable of guiding its motions through the water. The difference between the two transverse diameters of the spherosome is not as great as in Bolina, as will readily be seen by comparing the broad and narrow views of this Ctenophore (Figs. 22, 23). What is very peculiar in the genus Mnemiopsis is the peculiar development of the tentacular apparatus. It is not, as in Bolina, reduced to a simple bulb, with a few tentacles clustered at the base; but is more like what we find in Lesueuria, where the threads of the tentacular bulb are quite long, and have a decided tendency to spread fan-shaped on both sides of the bulb. We have a rather small tentacular bulb placed at the end of a long, slender tube, a short distance above the opening of the actinostome (*o*, Fig. 22). This tentacular bulb is protected by a kind of two-lapped hood (Fig. 24), the folds of which extend on each side along a groove towards the abactinal pole, to the very origin of the auricles, at *a*, Fig. 22, taking their origin at *o*, Fig. 22; their origin from the bulb is better seen in Fig. 24, where a portion of the two branches of the tentacular apparatus, extending along this groove, is represented. It is exactly as if we had the tentacles of a Pleurobrachia, instead of swimming and floating freely about, protected by a kind of cover, and thus pressed towards the spherosome, and prevented from moving freely about. The whole spherosome is covered with minute spots, clusters of lasso cells scattered irregularly over the surface. (See Fig. 23.)

Fig. 24.



From what we know of the amount of water which enters into the composition of Acalephs, and when we remember that not more than one half of one per cent. is animal matter, it seems strange that anything like a parasite should be found upon these Acalephs, and stranger still that this parasite should be able to find enough to live upon in such a delicate animal. As early as 1835 Sars had observed a species of intestinal worm (*Scolex acalepharum*) upon a large species of *Mnemia* (*M. norvegica* Sars), ten and even twelve specimens being found at-

Fig. 24. A part of the tentacular apparatus, near the opening of the actinostome, to show the mode in which the branches of the tentacle extend, under cover of a lappet, towards the abactinal extremity.

tached to the inner wall, near the upper part of the furrow, separating the lobes from the spherosome. Foster, in 1841, found a species of Filaria, which he called *Tetrastoma Playfairii*, upon a species of Cydippe; Greene and others have also seen parasites upon Hydroid Medusæ; and finally, in this species, five to eight worms, which resemble more a leech than anything else, though I cannot refer them to any of the genera which are described, attaining a length of an inch, and even an inch and a half, are frequently found attached to the inner wall, in the upper part of the long furrow, near the eye-speck. Hardly a specimen of this Medusa is found which has not one or two of these parasites. It is a long, flesh-colored, cylindrical worm, with five longitudinal white lines extending the whole length; the mouth, by which it is fastened to the jelly-fish, occupying the whole of the anterior part. This mouth can be closed, extended to a point, and, when inserted in the substance of the jelly-fish, it is expanded again like the mouth of a trumpet, and the worm is firmly fastened. These worms are sluggish in their movements, and when detached and disturbed hardly show signs of life by the slow contractions of their body. The worms live several days after they have been separated from the Medusæ.

Naushon, Buzzard's Bay (A. Agassiz).

LESUEURIA Milne Edw.

Lesueuria Milne Edw. Ann. Sc. Nat., XVI., 1841, p. 199.
Lesueuria Less. Zooph. Acal., p. 90. 1843.
Lesueuria Agass. Cont. Nat. Hist. U. S., III. p. 290. 1860.

Lesueuria hyboptera A. Agass.

In Lesueuria the tentacular ambulacra are by far the most developed; the locomotive flappers of the short ambulacra extend but to the beginning of the auricle; the immense size of this apparatus, projecting beyond the level of the mouth, and the winding of the tube running through the auricle, before it joins the lateral chymiferous tube, gives this tube a great length when compared to the longitudinal ambulacra, which run in an almost straight course from the abactinal pole till they meet the horizontal part of the tentacular branch which connects near the mouth with the opposite tentacular apparatus. The tentacular apparatus is similar to that of Bolina, and is also situated in the short transverse axis. The lobes of a Lesueuria can hardly be called by that name, as what corresponds to the lobes of Bolina are small projections scarcely reaching below the level of the mouth, and in which all we

find corresponding to the complicated windings of the longitudinal ambulacra are a few short, straight projections of the ambulacral tubes, running like spurs into the thickness of the spherosome.

The outline of our Lesueuria (Fig. 25) is entirely different from that of the Mediterranean; the latter is quite ellipsoidal, while the North American species shows a strong tendency to bulging out near the actinostome, and to imitate in its outline that of Bolina, mutilated specimens of which, when seen swimming in the water, can easily be mistaken for this species. It is only on noticing the position of the mouth, the great length of the auricles, that the mistake becomes apparent. Lesueuria is as transparent as Bolina, and even more sluggish; it grows to a large size, four inches in polar diameter, and is exceedingly abundant during September, large numbers being visible on almost any clear, hot day. Its phosphorescence is a very peculiar bluish light, of an exceedingly pale steel color, but very intense.

What is peculiar to our species is the almost rectangular outline which it has when seen from the broad side (Fig. 25). The shortness

Fig. 25.

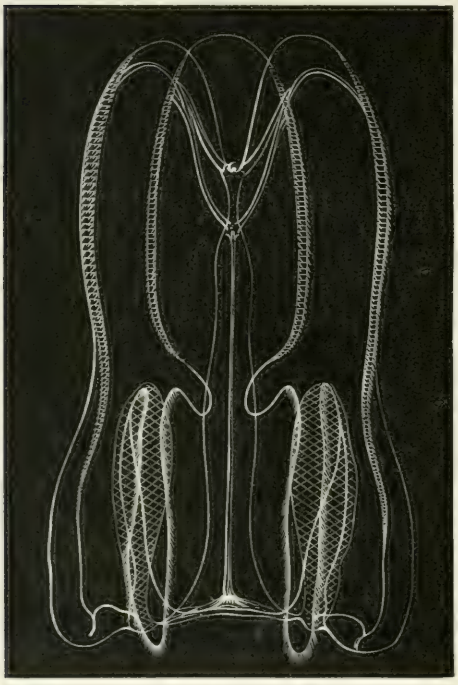
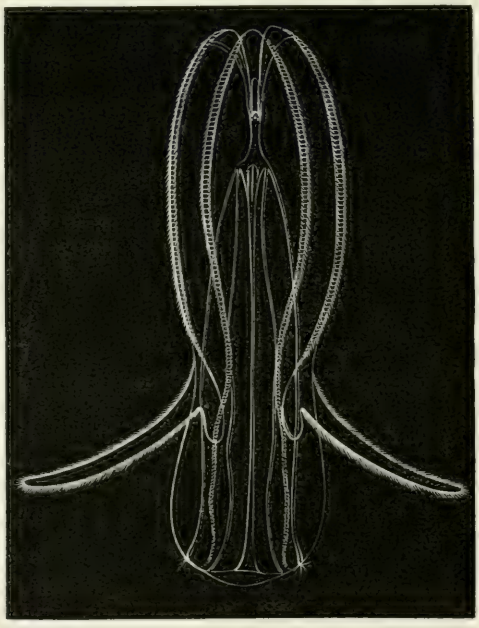


Fig. 26.



of the funnel; the extreme tenuity of the chymiferous tubes; the deep depression, or rather cut, in which the eye-speck is situated, for the abactinal part of the gelatinous spheromeres joins so closely above this that the eye-speck literally seems imbedded in the solidity of the

Fig. 25. Lesueuria seen from the broad side, natural size.
Fig. 26. Fig. 25 seen from the narrow side.

spherosome. The lateral tubes are also very attenuated, and bulge well out from the digestive cavity, as is seen in a profile view from the narrow side (Fig. 26). The view from the narrow side shows this species to be compressed to a far greater extent than anything we know in Bolina; approaching almost to Mertensia. When in motion the auricles are often held out extended from the body (Fig. 26), one pair bending one way, and the other in the opposite direction, as is shown in Fig. 27; the outline of the body when seen from the abactinal pole is nearly elliptical (Fig. 27), and we have not the strongly-ribbed appearance so characteristic of the other Ctenophoræ. The connection between the lateral and longitudinal ambulacra, forming a circular tube round the actinostome, can be traced in Fig. 28, and it differs in no essential way in its mode of formation from what we observe in Bolina.

Fig. 27.

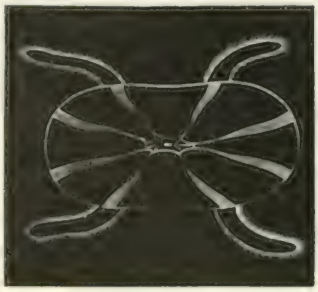
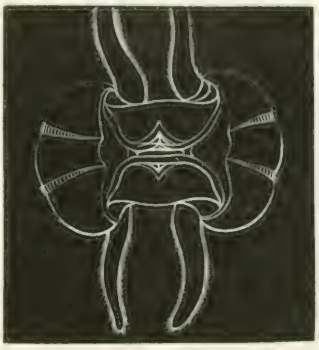


Fig. 28.



Massachusetts Bay, and Newport, R. I. (A. Agassiz).
Museum diagram No. 2 after A. Agassiz.

Family OCYROEÆ Less.

Ocyroeæ Less. Zooph. Acal., p. 98. 1843.
Ocyroeæ Agass. Cont. Nat. Hist. U. S., III. p. 292. 1860.

OCYROE Rang.

Ocyroe Rang (*non* Pér. et Les.). Mém. de la Soc. d'Hist. Nat., IV. p. 170. 1829.
Ocyroe Less. Zooph. Acal., p. 98. 1843.
Ocyroe Agass. Cont. Nat. Hist. U. S., III. p. 292. 1860.

Ocyroe maculata Rang.

Ocyroe maculata Rang. Mém. Soc. d'Hist. Nat. de Paris, IV. 1829, Pl. 20, Fig. 1.
Ocyroe maculata Less. Zooph. Acal., p. 99. 1843.
Ocyroe maculata Agass. Cont. Nat. Hist. U. S., III. p. 292. 1860.
Antilles (Rang).

Fig. 27. Lesueuria seen from the abactinal pole.
Fig. 28. Seen from the actinal pole, to show the connection of the lateral and longitudinal ambulacra.

Suborder SACCATÆ Agassiz.

Saccatæ Agass. Cont. Nat. Hist. U. S., III. p. 293. 1860.
Callianiridæ Esch. Syst. der Acal., p. 21. 1829.

Family MERTENSIDÆ Agass.

Mertensidæ Agass. Cont. Nat. Hist. U. S., III. pp. 196, 293. 1860.

MERTENSIA Less.

Mertensia Less. (*non* Gegenb.). Zooph. Acal., p. 100. 1843.

Mertensia ovum Mörch.

Cydippe (*Mertensia*) *ovum* Mörch. In Nat. Bid. til en Besk. af Grönland, p. 97. 1857.
Beroe ovum Fab. Faun. Groenl. 1780. No. 355.
Beroe cucullus Mod. Svensk. Vet. Ak. Nya Handl., XI. 1790.
Beroe pileus Scor. (*nec* Fab. *nec* Müll.). Arct. Reg., II. Pl. XVI. Fig. 4. 1820.
Cydippe ovum Esch. Syst. d. Acal., p. 25. 1829.
Cydippe cucullus Esch. Syst. d. Acal., p. 25. 1829.
Mertensia Scoresbyi Less. Zooph. Acal., p. 100. 1843.
Cydippe cucumis Less. (syn. not correct). Zooph. Acal., p. 105. 1843.
Mertensia cucullus Agass. Cont. Nat. Hist. U. S., III. p. 293. 1860.

The compression of Mertensia coincides with that of Pleurobrachia. The axis passing through the tentacular apparatus is more than twice as long as the cœliac diameter. What is very characteristic of this genus is the great distance at which the lateral chymiferous tubes are placed from the digestive cavity, and the close connection which is shown there to exist between the tentacular apparatus and the lateral tubes, the base of the tentacular apparatus seeming to give rise to this long, slender tube, enclosing the digestive cavity in its two wide arches, when seen from the broad side. (Fig. 29.) The spherosome rises so much above the opening for the passage of the tentacular apparatus, that it seems, in adult specimens, as if the tentacular ambulacra were the longest.

Only one large adult specimen of this jelly-fish has been taken in our Bay. It was at first mistaken for a large Pleurobrachia; but the great flattening of the spherosome, and the peculiar spiral motion which they keep up while active, soon enables one to distinguish them readily from that genus, while swimming in the water. The color, also, is of a light-pink hue; the spermaries are of a very brilliant crimson, the ovaries being more dull. It has the rosette of an Idyia, with the

edges smooth; the circumscribed area is quite small; the tentacles are but moderately long, apparently not capable of as great expansion as Pleurobrachia. Our species of Mertensia is exceedingly delicate; the specimens taken at Nahant and Eastport, though treated with the greatest care, not living more than a couple of hours when brought into confinement. I suppose this to be the *Beroe ovum* of Fabricius.

Fig. 29.

The difference between the tentacular chymiferous tubes and the median pairs is very marked in young specimens. In the youngest Mertensia observed, we find the same pear-shaped form noticed in young Pleurobrachia. (See Fig. 41.) The ambulacra, however, are far more advanced in comparison to the tentacles, and occupy nearly the whole of the spherosome (Fig. 30); the pouches of the ambulacra concealing almost entirely the digestive cavity. There are also very prominent orange pigment-cells, which are not found in the young of Pleurobrachia, along the rows of locomotive flappers; the tentacles remain simple much longer than in Pleurobrachia. The young Mertensia is not as much compressed as the young Pleurobrachia (compare Figs. 31 and 46, representing almost corresponding stages of Mertensia and of Pleurobrachia).

Fig. 30.

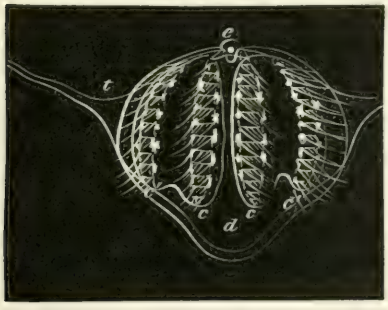


Fig. 31.

The compression goes on increasing with age, and in the adult it has become one of the striking characteristics of the genus. With advancing age the actinal part of the young Medusa becomes more prominent, while the ambulacra have remained nearly unchanged, the long and short ambulacra not retaining quite the same proportions they had before they were almost equally developed; the funnel has become

Fig. 29. Adult Mertensia seen from the broad side.
Fig. 30. Young Mertensia seen from the broad side, with a simple tentacle.
Fig. 31. The same as Fig. 30, seen from the abactinal pole.

formed, the digestive cavity (*d*) and the lateral tubes (*l*) are well defined. (Fig. 32.) In a view from below of this same individual (Fig. 33) we notice the narrowing of the large ambulacral pouch into somewhat more circumscribed tubes. In the next stage which is here represented (Fig. 34), the ambulacra have assumed still more the aspect of tubes, the funnel has elongated, the tentacles have begun to send out lateral processes, the lateral tubes extend nearly to the level of the mouth, the actinal part of the young Medusa having taken a still greater development, and having become as long as the ambulacral part. The tubes, both ambulacral and lateral, when seen from below (Fig. 35), are also more narrowed and better circumscribed. In the next stage the development of the actinal part of the spherosome (Figs. 36, 37) has become so striking, that we cannot fail to recognize in the young Acaleph a Mertensia. The difference between the cœliac and diacœliac axis is quite prominent, giving to the animal, when viewed from the broad (Fig. 36) or narrow side (Fig. 37), a totally different aspect. The tentacular apparatus differs from that of Pleurobrachia in being limited to the abactinal part of the spherosome, and not extending towards the actinostome, as in Pleurobrachia. In the young stages the lateral tubes are still quite close to the digestive cavity, and do not yet flare out, as in the adult. (See Figs. 29, 36.) The ambulacra are very nearly equally developed, the tentacular pairs and the median tubes differing but slightly in length. The tentacles are lashed and covered with large orange pigment-spots, similar to those of the rows of locomotive

Fig. 32

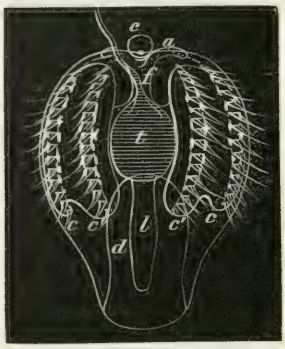


Fig. 33.

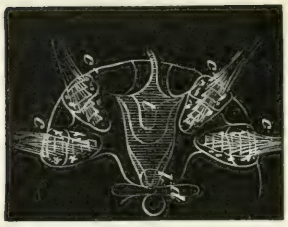


Fig. 34.

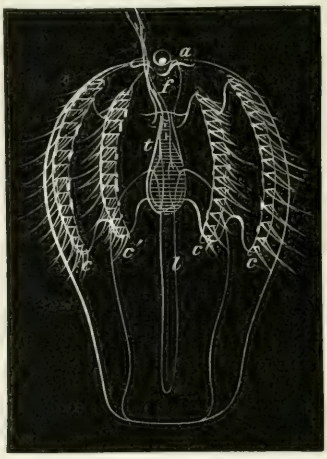


Fig. 35.

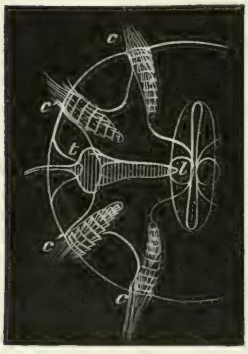


Fig. 32. Somewhat more advanced Mertensia, seen from the narrow side; the lateral tubes, *l*, are present.

Fig. 33. The same as Fig. 32, seen from the actinal pole.

Fig. 34. Still more advanced Mertensia, seen from the narrow side.

Fig. 35. The same as Fig. 34, seen from the actinal pole; the tubes are circumscribed, and the tentacular apparatus isolated.

flappers. The pigment-spots become smaller and less conspicuous with advancing age.

Fig. 36.

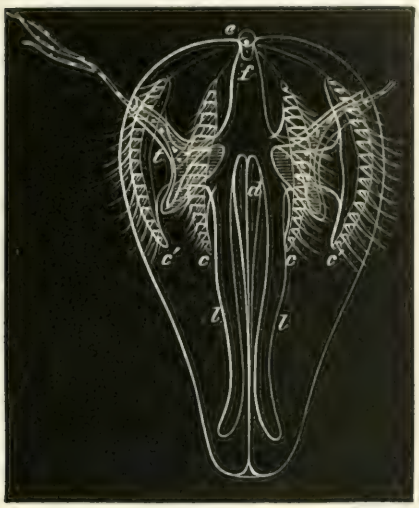
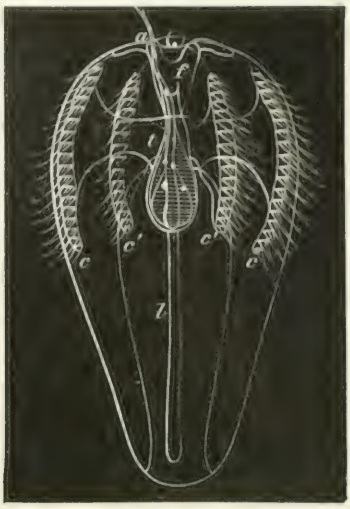


Fig. 37



This species is exceedingly common in Eastport harbor, during the month of September.

Arctic Ocean (Mertens, Scoresby); Baffin's Bay (Fabricius); Massachusetts Bay, and Eastport, Me. (A. Agassiz).

Museum diagram No. 3 after Alex. Agassiz.

Family CYDIPPIDÆ Gegenb. (*rest.* Ag.)

Cydippidæ Gegenb. Archiv f. Nat., 1856, I. p. 196.
Callianiridæ Esch. (*p. p.*) Syst. d. Acal., p. 21. 1829.
Cydippidæ Agass. Cont. Nat. Hist. U. S., III. p. 293. 1860.

PLEUROBRACHIA Flem.

Pleurobrachia Flem. Phil. Zoöl., II. p. 612.
Cydippe Esch. Syst. der Acal., p. 29. 1829.
Cydippe Less. Zooph. Acal., p. 104. 1843.
Pleurobrachia Agass. Mem. Am. Acad., IV. 1849, p. 314.
Pleurobrachia Agass. Cont. Nat. Hist. U. S., III. p. 203. 1860.

Fig. 36. Still further advanced Mertensia, seen from the broad side.

Fig. 37. Young Mertensia about in the same condition as that of the preceding figure, seen from the narrow side. The main branches of the ambulacral system have lost the character of pouches.

Pleurobrachia rhododactyla Agass.

Pleurobrachia rhododactyla Agass. Mem. Am. Acad., IV. p. 314, Pls. 1, 2, 3, 4, 5.
Pleurobrachia rhododactyla Agass. Cont. Nat. Hist. U. S., III. pp. 203, 294, Pl. 2ª. 1860.
Beroe pileus Fab. (*non* Flem., Müll., and Esch.). Faun. Grönl. 1780. No. 354.
Cydippe pileus Gould. Rep. Inv. Mass., p. 349. 1841.
Pleurobrachia rhododactyla Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Cydippe pileus Mörch. In Naturhist. Bid. til en Besk. af Grönland, p. 97. 1857.
Pleurobrachia Scoresbyi Mörch. In Naturh. Bid. til en Besk. af Grönland, p. 98. 1857.
Pleurobrachia rhododactyla Packard. List of Animals dredged near Caribou Island. 1863.

The young Pleurobrachia early assumes an outline resembling the adult; it is slightly pear-shaped, with two very small protuberances, like buttons, indicating the first appearance of the tentacles (Figs. 38–40, *t*), and has a very large transparent sphere (*e*) with two or

Fig. 38.

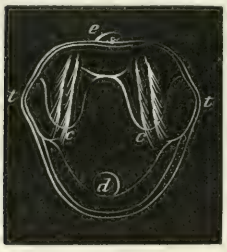


Fig. 40

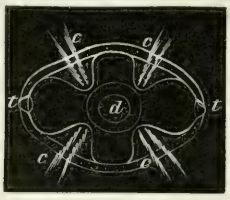
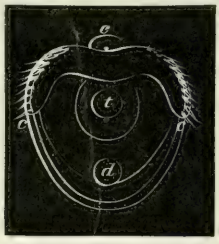


Fig. 39.



three granules, as an eye-speck. The first cavity formed in this embryo is a small spherical space (Figs. 38–40, *d*) near the pole opposite the eye-speck. As this grows larger it becomes elliptical, reaching to

Fig. 41

Fig. 42.

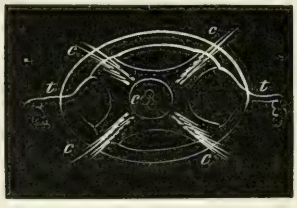
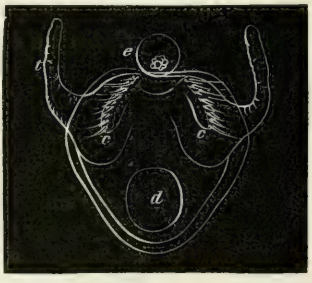


Fig. 43.



the base of the tentacular (Fig. 41, *t*) knob, which now extends, like the handle of a jar, beyond the outline; this cavity is the digestive cavity, and there is up to this time no sign of ambulacral tubes or cavi-

Fig. 38. Young Pleurobrachia seen from the broad side.
Fig. 39. Same as Fig. 38, seen from the narrow side.
Fig. 40. Same as Fig. 38, seen from below.
Fig. 41. Pleurobrachia somewhat more advanced, seen from the broad side.
Fig. 42. Same as Fig. 43, seen from above.
Fig. 43. Same as Fig. 42, seen from the broad side, older than Fig. 41.

ties of any kind. The position of the ambulacral system is early well defined by four short double rows of combs, each row not having more than three or four combs (Figs. 38–41). The spherosome early shows the great difference in the size of the longitudinal and cœliac diameters, the tentacular diameter being nearly twice as long as the other (Figs. 40, 42). The locomotive rows extend rapidly to the level of the upper part of the digestive cavity. At this time the ambulacral cavity makes its appearance as a small spherical cavity, in the same way as the digestive cavity. The ambulacral cavity increases rapidly, soon attains the size of the digestive cavity, and occupies the whole of the abactinal extremity of the animal (Fig. 43, *o*). At this time the young Pleurobrachia is quite pear-shaped, with solid tentacles about as long as the polar diameter. The ocular sphere is large, very prominent (Fig. 43, *e*). There are two large elliptical cavities, of nearly equal size (Fig. 43, *o*, *d*). In the next stage the two cavities differ in their outline, the ambulacral cavity becoming more and more rectangular, and the digestive cavity triangular, the two being separated by a wall which grows thinner and thinner. The combs of the ambulacral rows increase in size, and the flappers are quite long, equalling in length half the transverse diameter of the spherosome. The ambulacral cavity extends towards the abactinal region on both sides of the thickening of the wall, supporting the sensitive bulb. This is the first sign of the formation of the funnel (Fig. 44, *f*), and its division into the two branches, opening outwards. The compression of the digestive cavity is plainly seen at this stage, as when seen facing the tentacles the cavity comes close to the outer wall (Fig. 44), while when seen at right angles to the tentacular diameter it occupies but a much smaller space (Fig. 45). The tentacular bulb becomes more isolated, the tentacle is about three times as long as the polar diameter. During all this time, and from the first appearance of the locomotive flappers, the young Medusa moves about with the greatest rapidity, turning over in every possible direction, running round and round, with the digestive cavity forward, in the envelope of the egg, as if trying to make its escape from it; while at other times the young Medusa remains

Fig. 44.

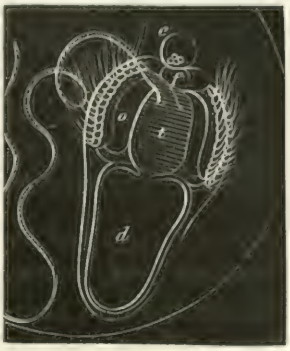


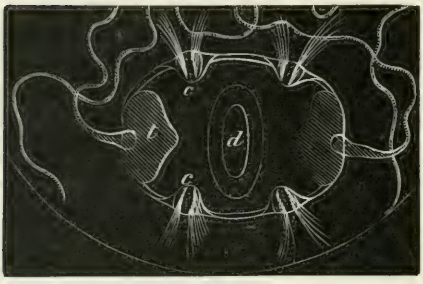
Fig. 45.

Fig. 44. Pleurobrachia in which the digestive cavity and the ambulacral cavity are already connected, immediately before the escape of the Medusa from the egg.

Fig. 45. Same as Fig. 44, somewhat less magnified, to show the relative size of egg envelope and embryo.

poised in the centre of the egg, rotating slowly on its axis, imitating, while still in the egg, all the movements which are so characteristic of the adult. The young Medusa, before it escapes from the egg, occupies a comparatively small space, having thus ample room for its manifold movements. In Fig. 44 the outline of a part of the egg is seen; Fig. 45 is the same as Fig. 44 from the opposite side, showing the whole egg.

Fig. 46.



Before the young leaves the egg, we find that the ambulacral cavity and digestive cavity connect by means of a small opening in the centre of the dividing wall, and at the same time a depression at the actinal pole soon increases sufficiently to pierce through the wall, and make an opening, the mouth (Fig. 46). The young Pleurobrachia now makes its escape from the egg, and the changes it undergoes are very rapid; the funnel becomes well isolated, and the digestive cavity quite compressed, and we see the first sign of the separation of the double row of locomotive flappers into two very distinct rows. At the same time, when facing the tentacular bulb, we see a small triangular pouch extending along the digestive cavity, which, when seen in profile, plainly appears to be nothing but a cœcum of the ambulacral cavity, formed exactly as in Bolina (Fig. 5). These pouches are the rudimentary lateral chymiferous tubes so characteristic of Ctenophoræ. At this stage the ambulacral flappers are not as near the abactinal pole as in former stages, on account of the elongation of portions of the spherosome. The lateral tubes increase rapidly in length, and soon extend to the level of the mouth (Fig. 47, *l*), while the forking of the ambulacral tubes becomes more deep. We notice also at this time a marked difference in the size of the ambulacral tubes. The tentacular ambulacra (those on each side of the tentacular apparatus) are much shorter than the longitudinal ambulacra (Fig. 48, *c*). The tentacle, also, is no longer a simple solid thread; long, slender offshoots, similar to the tentacle, have developed near the

Fig. 47.

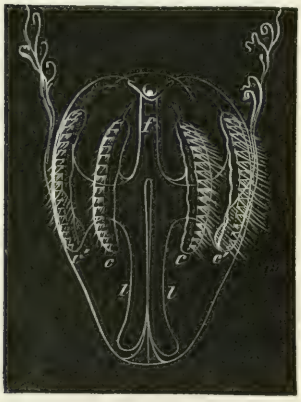


Fig. 46. Same as Fig. 44, seen from actinal side.

In all the preceding figures the embryo has been drawn without the egg envelope; but it must be remembered that the little Medusa does not escape from the egg till it reaches the condition of Fig. 44.

Fig. 47. Pleurobrachia swimming freely about, in which the lateral tubes, the funnel, have become highly developed; seen from the broad side.

point of attachment, and the peculiar abactinal system (Fig. 48) has also made its appearance. The young Pleurobrachia has now all the

Fig. 48.

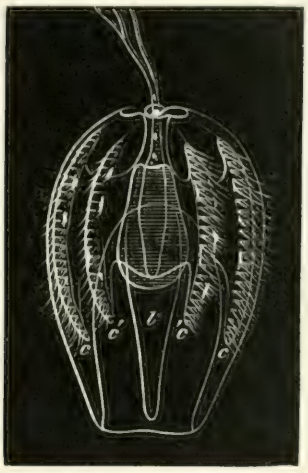
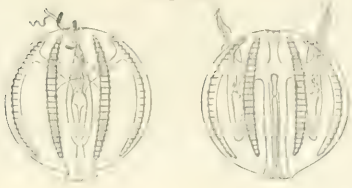


Fig. 49.

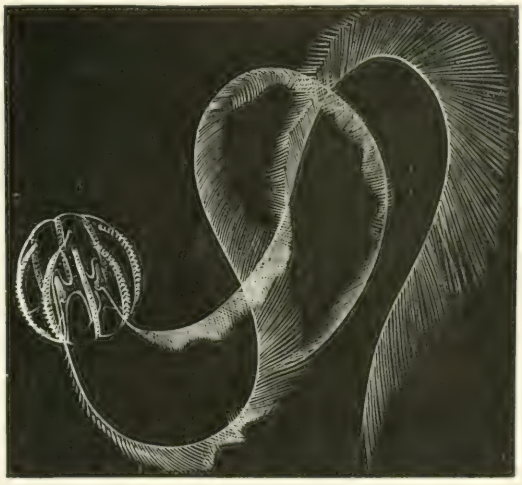
Fig. 50.



appearance of the adult, only it is more pear-shaped, and it is about one half of an inch in polar diameter. The ambulacra are yellowish, with large orange pigment-cells on the surface of the ambulacral tubes (Fig. 49).

The difference between the axes, the cœliac and the diacœliac, grows less and less with advancing age, till they assume the almost identical outlines of the adult, as seen in Fig. 50, which represents the cœliac and diacœliac views of an adult. In Figs. 47 and 48 we have also the first trace of the cirri which assume such graceful shape in the tentacles of the adult Medusa (Fig. 51); the cirri begin nearest the tentacular bulb, and there are at first but two or three at the base of each tentacle.

Fig. 51.



Greenland (Fabricius); New England (Agassiz).

Cat. No. 366, Nova Scotia, Anticosti Expedition, 1861.

Museum diagrams Nos. 4, 5, after L. Agassiz and Alex. Agassiz.

Fig. 48. Somewhat less advanced than Fig. 47, showing the lateral tubes from the narrow side, as a prolongation of the ambulacral cavity.

Fig. 49. Pleurobrachia about in condition of Fig. 47, seen from actinal pole.

Fig. 50. Adult Pleurobrachia, from the head and narrow side, natural size.

Fig. 51. Adult Pleurobrachia in a natural attitude, natural size.

Pleurobrachia Bachei A. Agass.

Pleurobrachia Bachei A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., III. p. 294. 1860.

Pleurobrachia Bachei A. Agass. resembles *Pleurobrachia rhododactyla* in its general appearance, having about the same size; the color of the spherosome and of the tentacles being nearly the same. The opening of the tentacular sac, however, is at a greater distance from the pole, and the tentacles come out more from the side of the spherosome than in *Pleurobrachia rhododactyla*. The cœliac cavity is also shorter, the funnel is longer, and the actinal portion of the sac shorter. The branches leading from the digestive cavity to the chymiferous tubes are much longer and more slender, the junction being above the opening of the tentacular sac, while in *Pleurobrachia rhododactyla* it is below, nearer the actinal pole. The greatest swelling of the spherosome is nearer the actinal pole, not in the middle of the actinal axis.

Found in the Gulf of Georgia, and entrance of Admiralty Inlet, W. T., during the whole Summer of 1859, from May to September.

Washington Territory (A. Agassiz).

Cat. No. 288, Gulf of Georgia, W. T., 1859, A. Agassiz.

JANIRA Oken.

Janira Oken. Lehrb. d. Naturg., III. 1815.

Janira cucumis Less.

Janira cucumis Less. Zooph. Acal., p. 104. 1843.
Beroe cucumis Mert. (*non* Fab. *n.* Esch.). Mém. Ac. St. Pet., p. 522, Pl. VIII. 1843.
Janira cucumis Agass. Cont. Nat. Hist. U. S., III. p. 294. 1860.

Between Sitka and Unalaschka (Mertens).

DRYODORA Agass.

Dryodora Agass. Cont. Nat. Hist. U. S., III. p. 196. 1860.
Eschscholtzia Less. (*ex. p.*). Zooph. Acal., p. 102. 1843.
Mertensia Gegenbaur (*non* Less.). Archiv f. Nat., 1856. I. p. 198.

Dryodora glandiformis Agass.

Dryodora glandiformis Agass. Cont. Nat. Hist. U. S., III. p. 294. 1860.
Beroe glandiformis Mert. Mém. Acad. St. Pet., p. 530, Pl. XI. 1833.
Eschscholtzia glandiformis Less. Zooph. Acal., p. 102. 1843.
Mertensia glandiformis Gegenb. Archiv f. Nat., 1856, I. p. 198.

Behring's Strait (Mertens).

Suborder EURYSTOMÆ Leuck.

Eurystomæ Leuck.; in Van d. Hoeven Handbuch d. Zool. German Transl. 1850.
Eurystomæ Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

Family BEROIDÆ Esch.

Beroidæ Esch. Syst. d. Acal., p. 38. 1829.
Beroidæ Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

BEROE Brown.

Beroe Brown. Nat. Hist. Jam., p. 384. 1756.
Medea Esch. (*ex p.*). Syst. d. Acal., p. 38. 1829.
Cydalisia Less. Zool. de la Coq., p. 101. 1829.
Cydalisia Less. Zooph. Acal., p. 138. 1843.
Beroe Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

Beroe punctata Cham. & Eysen.

Beroe punctata Cham. & Eys. Nov. Act., X. p. 361, Pl. 31, Fig. 1.
Beroe punctata Esch. Syst. d. Acal., p. 37. 1829.
Beroe punctata Blainv. Man. d'Actin., Pl. 7, Fig. 2. 1830.
Cydalisia punctata Less. Zooph. Acal., p. 139. 1843.
Beroe punctata McCr. Proc. Elliot Soc. N. H., p. 1. 1858.
Beroe punctata Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

McCrady has identified a species of Beroe found at Charleston with the *B. punctata* Esch. I am inclined to think that it may prove to be one of the species of Idyopsis found on the coast of Florida.

Charleston, S. C. (McCrady).

IDYIA Frem.

Idyia Frem. Nouv. Bull. Soc. Phil., 1809, p. 329.
Medea Esch. (*ex. p.*). Syst. d. Acal., p. 38. 1829.
Idyia Less. Zooph. Acal., p. 132. 1843.
Idyia Mert. Mém. Acad. St. Petersb., II. p. 532. 1833.
Idyia Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

Idyia ovata Less.

Idyia ovata Less. Zooph. Acal., p. 134. 1843.
Beroe Brown. Nat. Hist. Jam., p. 384. 1756.
Medusa Beroe Linn. Syst. Nat. ed. X. p. 660.
Beroe ovata Esch. Syst. d. Acal., p. 36. 1829.
Idyia ovata Agass. Cont. Nat. Hist. U. S., III. p. 295. 1860.

Is this not one of our species of Idyopsis?

Jamaica (Patrick Brown).

Idyia cucumis Less.

Idyia cucumis Less. Zooph. Acal., p. 133. 1843.
Beroe cucumis Fab. Fauna Grönl., 1780, No. 353.
Beroe cucumis Esch. Syst. d. Acal., p. 36. 1829.
Medea fulgens Less. Zooph. Acal., p. 136. 1843.
Beroe cucumis Mörch; in Naturh. Bid. af Grönland, p. 98. 1857.
Idyia cucumis Agass. Cont. Nat. Hist. U. S., III. p. 296. 1860.
? *Idyia borealis* Less. Zooph. Acal., p. 134. 1843.

The many species of Idyia which are described from the arctic parts of the Atlantic Ocean, and which have been identified with *Idyia cucumis* and *Idyia borealis* Less. by Professor Agassiz, are probably all identical with the *Beroe cucumis* of Fabricius.

Baffin's Bay (Fabricius).

Idyia roseola Agass.

Idyia roseola Agass. Cont. Nat. Hist. U. S., III. pp. 270, 296, Pls. 1, 2. 1860.
Idyia roseola Pack. List of Animals dredged near Caribou Island. 1863.

In the youngest Idyia which I have had the opportunity to observe the digestive cavity, the eight ambulacral rows, the lateral chymiferous tubes were already developed. When seen from above, the ambulacral cavity has the shape of an eight-lobed rosette, with loops of different size.

Fig. 52.

Fig. 53.

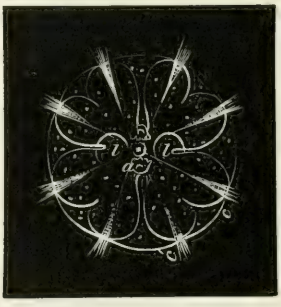
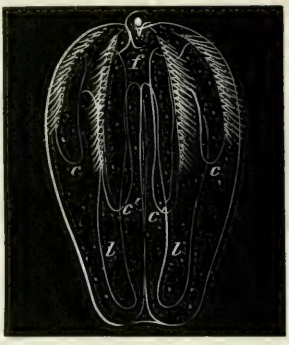


Fig. 54.



occupying half the space of the spherosome, seen in profile (Fig. 52), and the whole when seen from the abactinal pole (Fig. 53). We are struck by the immense size of the lateral tubes (*l*), and find that the inequality in the lobes of the ambulacral cavity is caused by the greater size of

In Idyia, owing to a mistake in the lettering of the figures, *c'* is the long tube, and *c* the short ambulacral tube, so that the lettering of Idyia does not exactly correspond to that of the other young Ctenophoræ.

Fig. 52. Young Idyia, seen from the narrow side.
Fig. 53. Fig. 52, seen from abactinal pole.
Fig. 54. Young Idyia, in which the ambulacral tubes are distinct, seen from the narrow side.

the longitudinal ambulacra, the rows of locomotive flappers extending but little way from the abactinal pole, as is the case in Pleurobrachia. We find also the whole spherosome covered with large pigment cells.

Fig. 56.

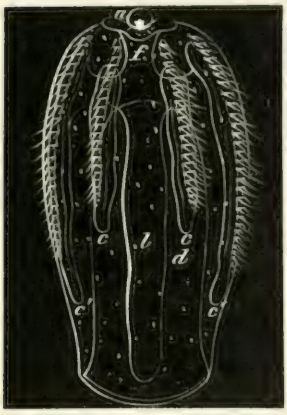


Fig. 55

Fig. 57

In specimens slightly older, the difference in size between these two sets of tubes becomes more marked in proportion as they become separated and distinct, as is seen in the two figures, in profile (Fig. 56) and

Fig. 59.

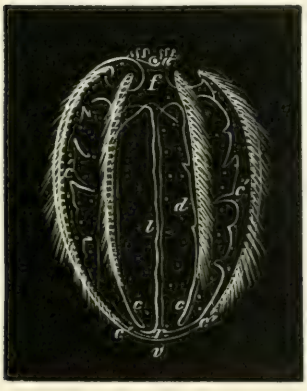


Fig. 58.

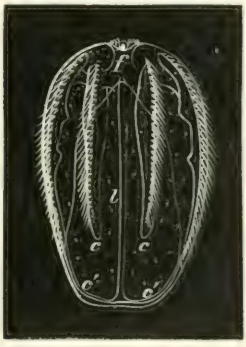
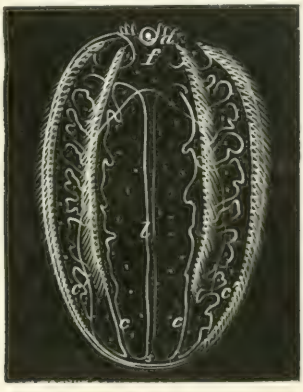


Fig. 60.



from above (Fig. 55). The manner in which the ambulacral tubes are formed, by the drawing up into loops of the original chymiferous cavity, is very easily followed in Idyia. It is the same in all the Ctenophoræ

Fig. 55. Fig. 54, seen from the abactinal pole.

Fig. 56. Somewhat more advanced than Fig. 54, seen from the broad side.

Fig. 57. The chymiferous tubes, c', have extended to level of actinostome; narrow side.

Fig. 58. The chymiferous tubes, c', have united with the lateral tubes, and formed a circular tube, towards which the short ambulacra, c, are fast pushing their way. First trace of the ramifications on the long tubes, c'. Figs. 58–60 are seen from the broad side.

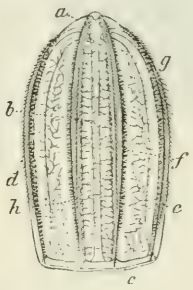
Fig. 59. The short ambulacra, c, have nearly united with the circular tube; the spurs of the ambulacra have become more numerous and quite prominent.

Fig. 60. The circuit is now complete between the short and long ambulacra. The spurs or ramifications of the chymiferous tubes are numerous, resembling somewhat those of the adult.

I have observed; but as the tubes of the other genera are so soon hidden by the rows of locomotive flappers, it becomes more difficult to follow this separation than in Idyia, where the ambulacra retain always a great size, and develop faster than the rows of flappers which cover them. The longitudinal ambulacra increase rapidly in length, pushing their way through the gelatinous mass (Fig. 56, *c'*) till they reach the level of the mouth (Fig. 57); they then bend inwards (Fig. 58) till they meet the lateral chymiferous tube. The lateral ambulacra go through the same process (Figs. 58, 59); and thus we have formed, by the junction of the ambulacra with the lateral chymiferous tubes, a circular tube round the mouth. (Fig. 60.) The distinction between the longitudinal and lateral ambulacra is always maintained by the length of the rows of locomotive flappers which cover the ambulacral tubes. The fringed abactinal apparatus is in the young a circular ring; afterwards it has four folds developed at the extremity nearest the sensitive bulb (Figs. 59, 61), which soon become fringes similar to those of the adult. Shortly before the circuit is thus completed (Figs. 58, 59), the ambulacra of the young Idyia give out a few lateral processes, the first traces of the ramifications of the ambulacra of the adult (Fig. 62), which become more and more numerous until the processes branch as in Fig. 60.

Fig. 61.

Fig. 62.



The short chymiferous tubes are, as in Pleurobrachia, on each side of the lateral tubes, while in Bolina this is not the case, the long tubes being near the short transverse axis.

Coast of New England, and northward to Bay of Fundy (Agassiz).

Catalogue No. 368, Nova Scotia, Anticosti Expedition, 1861.

Museum diagrams Nos. 6, 7, after Alex. Agassiz and L. Agassiz.

Idyia cyathina A. Agass.

Idyia cyathina A. Agass.; in Agassiz's Contrib. Nat. Hist. U. S., Vol. III. p. 296. 1860.

This species differs from the *Idyia roseola* Agass. of the coast of New England, by the sudden widening of the spherosome from the abactinal pole. It is widest at two thirds the distance from the mouth; it then tapers as suddenly for another third of the distance to the mouth, and

Fig. 61. Fig. 57, seen from the abactinal pole.

Fig. 62. Adult Idyia, reduced in size one half. *a*, anal opening; *b*, lateral radiating tube; *c*, circular tube; *d*, *e*, *f*, *g*, *h*, vertical rows of flappers. Seen from the broad side.

then very gradually. The actinal extremity of the spherosome is slender and exceedingly movable, and the edges of the actinostome can be extended so that it presents the appearance of two distinct lobes. The ovaries and spermaries are much longer sacs than in *I. roseola*, and not so numerous. The locomotive flappers do not extend as far down the chymiferous tubes as they do in our species, though this difference may only be one of age. Found in the Gulf of Georgia, W. T., and in the eastern part of the Straits of Fuca, during the summer of 1859. The habits of this Idyia are somewhat different from those of our species. Instead of the sluggish movements which characterize *Idyia roseola*, *Idyia cyathina* is very active, and seems to retain the embryonic features of the genus, — short rows of flappers, and great activity in its adult condition.

Northwest coast of North America (A. Agassiz).

Cat. No. 287, Gulf of Georgia, W. T., A. Agassiz, 1859.

IDYIOPSIS Agass.

Idyiopsis Agass. Cont. Nat. Hist. U. S., III. pp. 288, 296. 1860.

Short vertical axis; ambulacra very prominent; interambulacra concave; fringes of circumscribed area arranged in two prolonged circles; numerous branching tubes arising from circular tube; compression of the body very striking. (Agassiz.)

Idyiopsis Clarkii Agass.

Idyiopsis Clarkii Agass. Cont. Nat. Hist. U. S., III. pp. 288, 296, Figs. 101, 102. 1860.

It remains yet to be shown whether the two species of Idyiopsis here mentioned may not be identical with species of Idyia described by Eschscholtz as found on the Brazilian coast and in the Gulf of Mexico. The figures of Idyiopsis given by Professor Agassiz are here reproduced. (Figs. 63, 64.)

South Carolina (L. Agassiz).

Fig. 63.

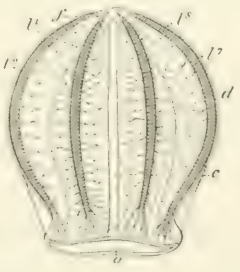


Fig. 64.

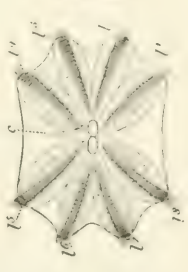


Fig. 63. Idyiopsis Clarkii seen from the broad side. *f*, funnel; l^2, l^7, anterior and posterior ambulacra; l^1, l^8, lateral ambulacra; *d*, digestive cavity; *o*, mouth; *c*, the lateral tube.

Fig. 64. Fig. 63, seen from the abactinal pole. *c*, circumscribed area; l^1, l^8, l^4, l^5, lateral ambulacra; l^2, l^3, l^6, l^7, anterior and posterior ambulacra.

Idyiopsis affinis Agass.

Idyiopsis affinis Agass. Cont. Nat. Hist. U. S., III. pp. 288, 296. 1860.

Gulf of Mexico, Tortugas, and Florida (L. Agassiz).

Order DISCOPHORÆ Esch.

Medusariæ Lamk. (*p. p.*). 1816.
Méduses Pér. et Les. (*p. p.*). 1809.
Discophoræ planerocarpæ Esch. Syst. d. Acal. 1829.
Discophoræ cryptocarpæ Esch. Syst. d. Acal. 1829.
Pulmograda Bl. (*p. p.*). Manuel d'Actinologie. 1830.
Medusidæ Br. (*p. p.*). Mém. Acad. St. Petersb. 1833.
Medusæ Less. (*p. p.*) Zooph. Acal. 1843.
Steganophthalma Forbes. Brit. Nak. Medusæ. 1848.
Acraspeda Gegenb. Syst. d. Med.; in Z. f. W. Zool. 1856.
Craspedota Gegenb. (*p. p.*). Syst. d. Med.; in Z. f. W. Zool. 1856.
Lucernariadæ Huxl. (*non* Johnst.). Lectures on Genl. Nat. Hist. . . . 1856.
Discophoræ Agass. Cont. Nat. Hist. U. S., IV. 1862.

Suborder RHIZOSTOMEÆ Agass.

Rhizostomeæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 9, 131. 1862.
Rhizostomidæ Esch. Syst. der Acal., p. 42. 1829.
Polystomæ Br. Mém. Acad. St. Petersb. 1835, Prod., p. 228.
Rhizostomidées Less. Zooph. Acal., p. 404. 1843.

Family RHIZOSTOMIDÆ Esch.

Rhizostomidæ Esch. Syst. der Acal., p. 42. 1829.
Rhizostomidæ Agass. Cont. Nat. Hist. U. S., Vol. IV. p. 149. 1862.

STOMOLOPHUS Agass.

Stomolophus Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 138, 151. 1862.

Stomolophus meleagris Agass.

Stomolophus meleagris Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 138, 151; III. Pl. 14.
Cephea rhizostoma Gibbes (*non* Lamk.). Fauna of South Carolina. 1847.

Atlantic Ocean, coast of Georgia.
Catalogue No. 335, Warsaw Shoals, Georgia, L. Agassiz.
Museum diagram No. 8 after L. Agassiz.

Family POLYCLONIDÆ Agass.

Polyclonidæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 140, 159. 1862.

POLYCLONIA Br.

Polyclonia Br. Mém. Acad. St. Petersburg, p. 396, Pls. 21 – 23. 1838.
Polyclonia Agass. Cont. Nat. Hist. U. S., IV. p. 139. 1862.

Polyclonia frondosa Agass.

Polyclonia frondosa Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 139, 159, III. Pls. 13, 13ª.
Medusa frondosa Pall. Spicil. Zool., p. 30, Pl. 2, Figs. 1 – 3.
Cassiopea frondosa Lamk. (*non* Til.). Anim. s. Vert., II. p. 512.
Cassiopea frondosa Esch. Syst. d. Acal., p. 43. 1829.
Cassiopea Pallas Pér. et Les. Hist. Gén. d. Méd.; in An. Mus., XIV. p. 45.
Medusa frondosa Bosc. Hist. Nat. d. Vers., II. p. 170.
Cassiopea frondosa Less. Zooph. Acal., p. 405. 1843.

West Indies (Pallas); Florida, Key West, and Key Largo (L. Agassiz).
Cat. No. 332, Tortugas, Fla., March, 1858, L. Agassiz.
Cat. No. 333, Key West, Fla., March, 1858, L. Agassiz and J. E. Mills.
Cat. No. 334, Key West, Fla., March, 1858, L. Agassiz and J. E. Mills.
Cat. No. 346, Florida, L. Agassiz.
Cat. No. 383, Havana, Professor F. Poey.
Museum diagram No. 8, after L. Agassiz.

Suborder SEMÆOSTOMEÆ Agass.

Semæostomeæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 9, 159. 1862.

Family AURELIADÆ Agass.

Aureliadæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 80, 159. 1862.

AURELIA Pér. et Les.

Aurelia Pér. et Les. Ann. du Mus., XIV. p. 45. 1809.
Aurelia Less. Zooph. Acal., p. 348. 1843.
Aurelia Agass. Cont. Nat. Hist. U. S., IV. p. 159. 1862.
Medusa Linn. Faun. Suec., p. 511.
Medusa Esch. Syst. der Acal., p. 61. 1829.
Ephyra Pér. et Les. Hist. Gén. des Méd., p. 42.
Ocyroe Pér. et Les. Hist. Gén. des Méd., p. 43.
Evagora Pér. et Les. Hist. Gén. des Méd., p. 31.
Scyphistoma Sars. Bidrag til Söedyrenes Nat. 1829.
Rhizostoma Esch. Syst. d. Acal., p. 45. 1829.
Strobila Sars. Beskriv. . . . over Polyp, . . . p. 16. 1835.
Diplocraspedon Br. Prod. Mém. Acad. St. Petersburg, p. 226. 1835.
Monocraspedon Br. Prod. Mém. Acad. St. Petersburg, p. 225. 1835.
Claustra Less. Zooph. Acal., p. 378. 1843.
Biblis Less. Zooph. Acal., p. 339. 1843.

Aurelia flavidula Pér. et Les.

Aurelia flavidula Pér. et Les. Ann. Mus., XIV. p. 47. 1809.
Aurelia flavidula Less. Zooph. Acal., p. 376. 1843.
Medusa aurita Fab. Faun. Grön., No. 356. 1780.
Aurelia aurita Gould. Rep. Inv. Mass., p. 348. 1841.
Aurelia flavidula Gould. Rep. Inv. Mass., p. 348. 1841.
Ephyra octolobata Gould. Rep. Inv. Mass., p. 348. 1841.
Aurelia aurita Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Aurelia aurita Mörch; in Nat. Bid. til en Besk. af Grönl., p. 95. 1857.
Aurelia sex-ovariis Mörch; in Nat. Bid. til en Besk. af Grönl., p 95. 1857.
Aurelia flavidula Agass. Cont. Nat. Hist. U. S., III. Pls. 6, 7, 8, 9, 11, 11ª, 11ᵇ; Pl. 10, Figs. 18, 22, 31, 32, 36; Pl. 10ᵃ, Figs. 4ᵇ, 13, 15ᵃ, 16–41; Pl. 11ᶜ, Figs. 1–13; IV. pp. 10, 160.
Aurelia flavidula Packard. A List of Animals . . . 1863.

Fig. 65.

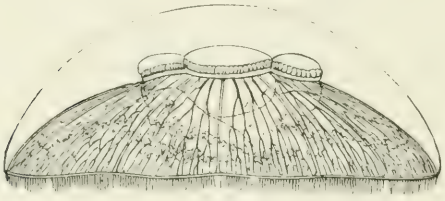
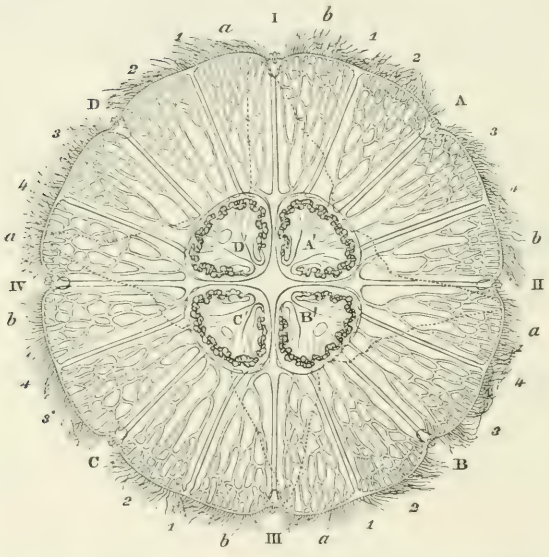


Fig. 66.



Occurs from March to the end of October; they collect together, and form large banks at the spawning season. Professor Agassiz has already spoken of the possibility of this species proving identical with the Northern European *Aurelia aurita*. But this, as well as the identity of *Cyanea arctica* with the European representative, can only be decided after renewed examination of these species.

Figs. 65, 66 are copied from Professor Agassiz's Contributions; they give a profile, and a view from the abactinal pole, of our Aurelia.

Greenland (Fabricius); New England (Gould, Agassiz).

Cat. No. 337, Nahant, 1861, L. Agassiz.
Cat. No. 338, Nahant, 1861, A. Agassiz.
Cat. No. 339, Nahant, 1858, L. Agassiz.
Cat. No. 340, Boston, 1862, H. J. Clark.
Cat. No. 341, Trenton, Me., 1860, Verrill and Shaler.
Cat. No. 347, Boston, 1862, H. J. Clark.
Cat. No. 367, Gulf of St. Lawrence, 1861, Anticosti Expedition.
Museum diagrams Nos. 9, 10, 11, after L. Agassiz.

Fig. 65 is a profile view of Aurelia flavidula, much reduced.

Fig. 66 an abactinal view of Aurelia flavidula. I, II, III, IV, are the ambulacral zones; A, B, C, D, the interambulacral zones; 1, 2, 3, 4, *a*, *b*, the respective halves of these systems.

Aurelia labiata Cham. et Eysen.

Aurelia labiata Cham. et Eysenh. N. Acta, X. p. 358, Pl. 38, Fig. **1.**
Medusa labiata Esch. Syst. d. Acal., p. 64. 1829.
Ocyroe labiata Bl. Man. d'Actinol., Pl. 42, Figs. 1, 2. 1834.
Aurelia labiata Less. Zooph. Acal., p. 377. 1843.
Aurelia labiata Agass. Cont. Nat. Hist. U. S., IV. p. 160. 1862.

Many of the Discophoræ of the southern part of the Northwest Coast must breed during the whole year, as I have found the adult with the ovaries fully developed during nearly every month of the year, in the harbor of San Francisco. This is at least the case with Phacellophora and Aurelia, which are the two most common genera of the harbor of San Francisco. Further north, however, in the Gulf of Georgia, the Discophoræ pass the winter in their hydra state.

North California (Cham. and Eysen.); California (Eschscholtz); San Francisco Bay (A. Agassiz).

Aurelia marginalis Agass.

Aurelia marginalis Agass. Cont. Nat. Hist. U. S., IV. pp. 86, 160. 1862.

Florida, Key West (L. Agassiz).
Cat. No. 352, Key West, Fla., L. Agassiz.

Family STHENONIÆ Agass.

Sthenoniæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 115, 161. 1862.

HECCÆDECOMMA Br.

Heccædecomma Brandt. Mém. Acad. St. Petersb., p. 300. 1838.
Heccædecomma Agass. Cont. Nat. Hist. U. S., IV. p. 161. 1862.

Heccædecomma ambiguum Br.

Heccædecomma ambiguum Br. Mém. Acad. St. Petersb., p. 300, Pls. 27, 28. 1838.
Heccædecomma ambiguum Agass. Cont. Nat. Hist. U. S., IV. p. 161. 1862.
Cyanea ambigua Less. Zooph. Acal., p. 388. 1843.

A species of this genus was observed in the Straits of Fuca, agreeing with the description and figures of Mertens so closely, that it is probable he observed this same species on the coast of Russian North America.

Port Townshend, W. T. (A. Agassiz).

PHACELLOPHORA Br.

Phacellophora Br. (*non* Huxl.). Prod. Mém. Acad. St. Pet., p. 223. 1835.
Phacellophora Less. Zooph. Acal., p. 343. 1843.
Phacellophora Agass. Cont. Nat. Hist. U. S., IV. p. 161. 1862.

Phacellophora camtschatica Br.

Phacellophora camtschatica Br. Mém. Acad. St. Petersb., p. 366, Pl. 8. 1838.
Phacellophora camtschatica Less. Zooph. Acal., p. 344. 1843.
Phacellophora camtschatica Agass. Cont. Nat. Hist. U. S., IV. p. 161. 1862.

The number of species of large Discophorous Medusæ found on the western coast of North America gives to the Acalephian Fauna of California a very characteristic stamp, when compared with that of the eastern coast.

Petropaulowsk (Mertens); San Francisco Bay (A. Agassiz).

Family CYANEIDÆ Agass.

Cyaneidæ Agass. Cont. Nat. Hist. U. S., Vol. IV. pp. 114, 161. 1862.

CYANEA Pér. et Les.

Cyanea Pér. et Les. Ann. du Mus., XIV. p. 51. 1809.
Cyanea Esch. Syst. der Acal., p. 67. 1829.
Cyanea Cuv. Règ. An. 1818.
Cyanea Less. Zooph. Acal., p. 379. 1843.
Cyanea Agass. Cont. Nat. Hist. U. S., Vol. IV. p. 161. 1862.

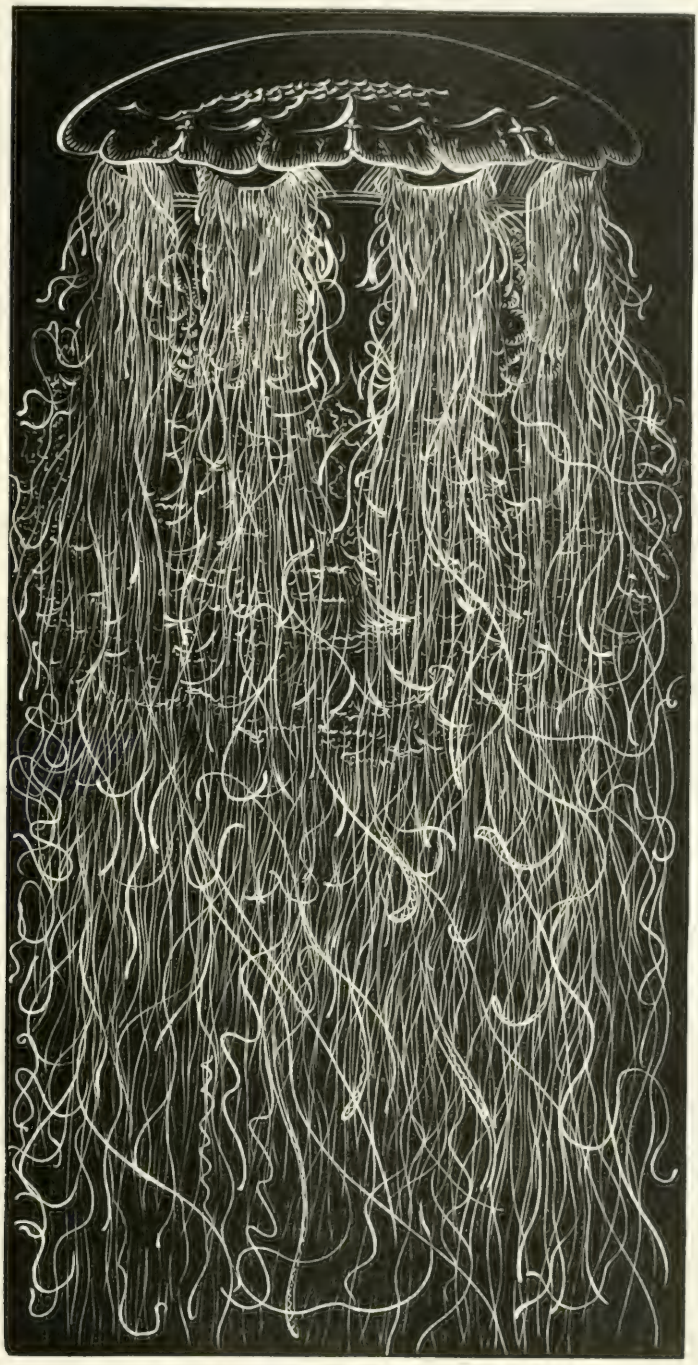
Cyanea arctica Pér. et Les.

Cyanea arctica Pér. et Les. Ann. Mus., XIV. p. 51. 1809.
Cyanea arctica Agass. Cont. Nat. Hist. U. S., IV. pp. 87, 162; Vol. III., Pls. 3, 4, 5, 5ª; Pl. 10, Figs. 1–17, 19–21, 23–30, 33–35, 37–38; Pl. 10ª, Figs. 1–4ª, 5–12ª, 14, 15, 17–40.
Medusa capillata Fab. (*non* Lin.) Faun. Groenl. No. 358. 1780.
Cyanea Postelsii Gould (*non* Br.). Rep. Inv. Mass., p. 347.
Cyanea Postelsii Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Cyanea arctica Mörch. In Naturh. Bid. til en Besk. af Grönl., p. 95. 1857.
Cyanea arctica Packard. Canad. Nat. Dec. 1863.

This species attains an enormous size. I measured myself a specimen at Nahant, the disk of which had attained a diameter of seven and a half feet, the tentacles extending to a length of more than one hundred and twenty feet. Our total ignorance of the young of these large Discophoræ is due to their peculiar habits. As has already been suggested, they probably remain a great part of the time groping about

the bottom of the sea, apparently coming to the surface only in their adult condition. Having accidentally visited the wharves of Province-

Fig. 67.



town harbor early one morning, between four and five, I was astonished to perceive what a large number of young Cyaneæ were floating

Fig. 67. Cyanea arctica very much reduced. The tentacles are cut off for want of room.

about, measuring all the way from a quarter of an inch to three inches in diameter. On my return to the same place at seven o'clock, although not a breath of air had ruffled the surface, they had all returned to deeper water. The early habits of the young Cyanea may be only one of many similar instances of early rising among Acalephs. Fig. 67 is copied from the Contributions of Professor Agassiz.

Greenland (Fabricius); Northeastern Coast of America, from Bay of Fundy to Boston Harbor (Gould, Agassiz); Long Island Sound, Vineyard Sound (A. Agassiz).

Cat. No. 326, Chelsea Beach, Oct. 1851, L. Agassiz.

Cat. No. 327, Nahant, Aug. 1858, L. Agassiz.

Cat. No. 328, Nahant, Aug. 1858, L. Agassiz.

Cat. No. 369, Gulf of St. Lawrence, 1861, Anticosti Expedition.

Museum diagrams Nos. 12, 13, after L. Agassiz.

Cyanea fulva Agass.

Cyanea fulva Agass. Cont. Nat. Hist. U. S., IV. pp. 119, 162. 1862.

The youngest specimen of Cyanea which has been observed measured about one third of an inch in diameter. Its peculiar habit of always remaining at the bottom of the vessel in which it was kept, seemed to explain — until the observations, above mentioned, of the early habits of *Cyanea arctica* — the periodic appearance of adult Medusæ at certain times of the year, simply for the purpose of spawning, while for the remainder of their life they remain groping near the bottom. In general appearance the young Cyanea resembles the Cyaneidæ. It has but few marginal tentacles, the centre one being developed far above the others; the separate lobes of the actinostome are, however, distinct, and do not form the inextricable mass of curtains surrounding the actinostome of a Cyanea. The digitate appendages are developed in pairs on each side of a median line, indicating the position of the future genital organs. This gives us at once the relative position of the Cyaneidæ and Pelagidæ, the latter being only permanent forms resembling somewhat embryonic Cyaneidæ.

Long Island Sound (L. Agassiz); Vineyard Sound (A. Agassiz).

Cat. No. 331, Naushon, A. Agassiz, Sept. 1861. Young.

Cyanea versicolor Agass.

Cyanea versicolor Agass. Cont. Nat. Hist. U. S., IV. pp. 119, 162. 1862.

South Carolina (L. Agassiz).

Cat. No. 329, Charleston, S. C., 1852, L. Agassiz.

Cyanea Postelsii Br.

Cyanea Postelsii Br. Mém. Ac. St. Pet., p. 375, Pl. 12, 13, 13ª. 1838.
Cyanea Postelsii Agass. Cont. Nat. Hist. U. S., IV. p. 162. 1862.
Cyaneopsis behringiana Br. Mém. Ac. St. Pet., Pl. 11, Fig. 1. 1838. Young?
? Cyanea ferruginea Esch. Syst. d. Acal., p. 70. 1829.
Cyanea Postelsii Less. Zooph. Acal., p. 387. 1843.

This species is extremely abundant during the Fall, in the Gulf of Georgia and the Straits of Fuca, and rivals in size its representative on the eastern shores of North America.

Kamtschatka, Aleutian Islands, and Western Coast of North America (Eschscholtz); North Pacific, Norfolk Sound, between Sitka and Unalaschka (Mertens); Port Townsend, W. T. (A. Agassiz).

Family PELAGIDÆ Geg.

Pelagidæ Gegenb. Zeitsch. f. Wiss. Zool., VIII. p. 210. 1856.
Pelagidæ Agass. Cont. Nat. Hist. U. S., IV. pp. 121, 163. 1862.

PELAGIA Pér. et Les.

Pelagia Pér. et Les. Ann. du Mus., XIV. p. 37. 1809.
Pelagia Esch. Syst. der Acal., p. 72. 1829.
Pelagia Less. Zooph. Acal., p. 388. 1843.
Pelagia Agass. Cont. Nat. Hist. U. S., IV. p. 163. 1862.
Dianœa Lam. Syst. An. s. Vert., II. p. 507.

Pelagia cyanella Pér. et Les.

Pelagia cyanella Pér. et Les. Ann. du Mus., XIV. p. 37. 1809.
Pelagia cyanella Esch. Syst. der Acal., p. 75. 1829.
Pelagia cyanella Bosc. Hist. Nat. des Vers., II. p. 140, Pl. 17, Fig. 3.
Pelagia cyanella Agass. Cont. Nat. Hist. U. S., IV. pp. 128, 164, III. Pls. 13, 13ª, Pl. 12.
Medusa pelagia Swartz. Konig. Vetensk. Akad. 1788.
Medusa pelagia Löffling. Reise, p. 105.
Medusa pelagia Lin. Syst. Nat.
Pelagia americana Pér. et Les. Ann. du Mus., XIV. p. 39. 1809.
Pelagia noctiluca Cham.; in Choris' Voyage Pittoresque, p. 3.
Pelagia denticulata Pér. et Les. Ann. du Mus., XIV. p. 38.
Dianœa cyanella Lamk. An. s. Vertèb., II. p. 507.
Dianœa denticulata Lamk. An. s. Vertèb., II. p. 507.

This species (Fig. 68) is found along the Florida Reef. In this genus the eggs develop directly into the young Medusæ, and the embryos are never attached to the ground.

Caribbean Sea (Swartz, Löffling); Coast of Florida, Tortugas (L. Agassiz).

Fig. 68. Pelagia cyanella Pér. et Les. (copied from Agassiz's Contributions). *a*, umbrella; *m*, actinal appendages; *t*, marginal tentacles.

Pelagia Brandtii Agass.

Pelagia Brandtii Agass. Cont. Nat. Hist. U. S., IV. p. 164. 1862.
Pelagia denticulata Br. (*non* Pér. et Les.). Mém. Acad. St. Pet., p. 383, Pl. 14, Fig. 2. 1838.

Aleutian Islands (Mertens).

DACTYLOMETRA Agass.

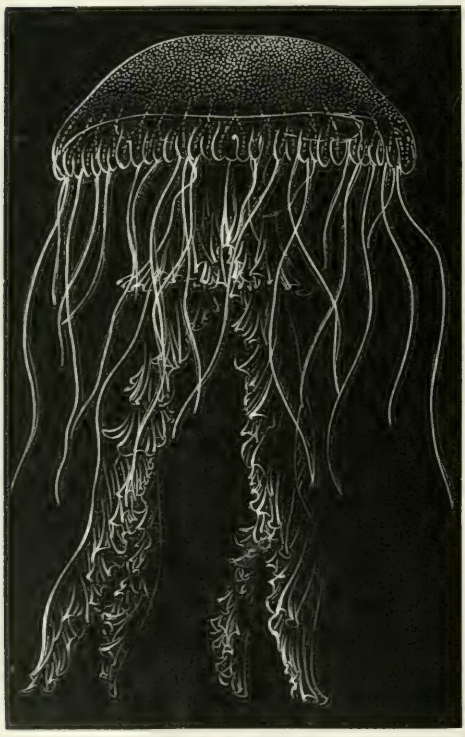
Dactylometra Agass. Cont. Nat. Hist. U. S., IV. pp. 125, 166. 1863.
Chrysaora Esch. (*p. p.*). Syst. d. Acal., p. 78. 1829.

Dactylometra quinquecirra Agass.

Dactylometra quinquecirra Agass. Cont. Nat. Hist. U. S., IV. pp. 125, 166. 1862.
Pelagia quinquecirra Des. Proc. Bost. Soc. N. H., p. 76. 1848.

Mr. Desor has described, in the Proceedings of the Boston Society of Natural History, a Pelagia under the name of *P. quinquecirra;* as his description is hardly sufficient to enable one to recognize it, I add the following particulars, on the supposition that the Pelagia which I found at Naushon is identical with the one described by Mr. Desor.

Fig 69



Several specimens of this Pelagia were taken at Naushon, the disk measuring from four to eight inches in transverse diameter, and one and a quarter to two inches in height. The general color of the disk is yellowish blue, the surface being covered with reddish-brown spots (Fig. 69), crowded more thickly towards the abactinal pole. The spotted surface does not reach the margin of the disk; only dotted lines extend from the lobes until they are lost in the more numerous spots of the central part. The marginal tentacles have the same color as the spots of the disk. There are five between each of the eight eyes, arranged, one, the largest, in the middle of the broader central lobe, and one on each side

Fig. 69. Dactylometra quinquecirra Agass. one fourth the natural size.

of the smaller lobe, the shorter tentacles being placed nearest the eyes. There are eight marginal lobes in which the eyes are placed, eight large lobes in the middle of the space between the eyes, from which the large tentacles arise, and the space between this large lobe and the lobe of the eye is occupied by the small lobes on the sides of which the smaller marginal tentacles are placed, — making in all thirty-two marginal lobes. The fringes of the actinostome extend in four simple thick lobes, with frilled edges, about twice the length of the transverse diameter; they are flesh color. The ovaries are seen from above as four large yellow bunches. These Medusæ are nocturnal in their habits; they are only occasionally found floating at the surface during the day, while at night, in the same localities, the bottom swarms with these large masses of dull phosphorescence, moving about with the greatest rapidity. When kept in tanks, they remain torpid during the day at the bottom of the jars, and when night comes on begin to become more animated, and soon move briskly about, emitting a dull phosphorescent light. This Pelagia is always accompanied by a species of Clupeoid, found in the folds of the fringes of the actinostome, moving along with the jelly-fish, which, when they are pushed off accidentally, rush back to their place of shelter. From twenty to thirty specimens have been found swimming in the fringes of the actinostome. It is strange that the fish should go there for shelter, for every once in a while one of them pays the penalty by being swallowed, without this disturbing the others in the least; they in their turn find food in the lobes of the actinostome, and even eat the folds themselves, until their turn comes to be used as food. I have seen in this way three fishes eaten during the course of as many days. The specimens measured about an inch in length. Sars, Leuckart, and Peach have observed this same kind of parasitism of certain species of fishes upon other Discophoræ. Nor is this limited to Acalephs; some species of Holothurians, and even a Culcita, are said to give refuge to fishes.

It is somewhat strange that almost all the Medusæ which have been observed are found in the brighest sunshine only, or in very dark nights. Early in the morning, and till about ten o'clock, even on clear days, Medusæ do not make their appearance, while from eleven till one or two o'clock they can be caught in abundance. After that time they disappear gradually, and late in the afternoon, towards sunset, it is rare to see a single jelly-fish. Between nine and twelve o'clock at night, they come to the surface again; and that hour, in fact, is one of the most favorable for collecting, in spite of the darkness.

Nantucket Bay (Desor); Naushon (A. Agassiz); between Bermudas and Azores (J. Drayton).

Cat. No. 343, Naushon, Mass., Sept. 1861, A. Agassiz.

Cat. No. 388, Bermudas, A. S. Bickmore.

POLYBOSTRICHA Br.

Polybostricha Br. Mém. Acad. St. Petersb., p. 384. 1838.
Polybostricha Agass. Cont. Nat. Hist. U. S., IV. pp. 126, 166. 1862.

The species of Polybostricha and Melanaster which are here enumerated were observed during a calm off the bar of San Francisco; and although tolerably accurate notes were taken at the time, yet they are not sufficient to warrant the description of these species under new names. They are therefore mentioned here more for the sake of the geographical distribution of these genera; and as some of the marine animals of Kamtschatka are found on the coast of California, it is by no means improbable that the species I have referred to the figures of Brandt will prove, on closer examination, to be identical with them.

Polybostricha helvola Br.

Polybostricha helvola Br. Mém. Acad. St. Petersb., Pl. 15, p. 384. 1838.
Polybostricha helvola Agass. Cont. Nat. Hist. U. S., IV. p. 166. 1862.
Chrysaora helvola Less. Zooph. Acal., p. 402. 1843.
Polybostricha sp. A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 166.

Aleutian Islands, Sitka (Mertens); Punta de los Reyes, California (A. Agassiz).

MELANASTER Agass.

Melanaster Agass. Cont. Nat. Hist. U. S., IV. pp. 126, 166. 1862.
Chrysaora Br. (*p. p.*). Mém. Acad. St. Petersb., p. 385. 1838.

Melanaster Mertensii Agass.

Melanaster Mertensii Agass. Cont. Nat. Hist. U. S., IV. p. 166. 1862.
Chrysaora melanaster Br. Mém. Acad. St. Petersb., Pls. 16, 17, p. 385. 1838.
Chrysaora melanaster Less. Zooph. Acal., p. 403. 1843.
Melanaster sp. A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 166. 1862.

Kamtschatka and Avatska Bay (Mertens); off San Francisco Bar (A. Agassiz).

Suborder HAPLOSTOMEÆ Agass.

Haplostomeæ Agass. (excl. *Lucernariæ* A. Ag.). Cont. Nat. Hist. U. S., IV. p. 167. 1862.

Family THALASSANTHEÆ Less.

Thalassantheæ Less. Zooph. Acal., p. 298. 1843.
Thalassantheæ Agass. Cont. Nat. Hist. U. S., IV. p. 167. 1862.
Æginidæ Gegenb. Zeits.. f. W. Zool., VIII. p. 258. 1856.
Æginidæ McCr. Gymn. Charl. Harb., p. 107.

FOVEOLIA Pér. et Les.

Foveolia Pér. et Les. Ann. du Mus., XIV. p. 27. 1809.
Foveolia Agass. Cont. Nat. Hist. U. S., IV. p. 168. 1862.
Cunina Esch. Syst. d. Acal., p. 116. 1829.
Cunina Bl. Man. d'Actinol., p. 279. 1834.
Cunina Less. Zooph. Acal., p. 301. 1843.
Cunina Lamk. Syst. Anim. s. Vert., III. p. 142.
Cunina Gegenb. Zeit. f. Wiss. Zool., p. 259. 1856.
Cunina McCr. Proc. Elliot Soc., p. 108. 1857.

Foveolia octonaria A. Agass.

Cunina octonaria McCr. Proc. Elliot Soc., Pl. XII. Figs. 4, 5, p. 109.
Cunina octonaria Agass. Cont. Nat. Hist. U. S., IV. p. 168. 1862.
Cunina octonaria McCr. Pls. 4, 5, 6, 7, for Embryolog. Hist.; Elliot Soc., pp. 1 – 36. 1856.

Charleston, S. C. (McCrady).
Museum diagram No. 15, after McCrady.

CAMPANELLA Bl.

Campanella Bl. (*non* Less.). Man. d'Actin., p. 286. 1834.
Campanella Agass. Cont. Nat. Hist. U. S., IV. p. 169. 1862.
Æginopsis J. Müll. (*non* Br.). Archiv f. Anat., p. 272. 1851.

Fritz Müller was the first to show (Wieg. Archiv., 1861) that the position of the Æginidæ and Charybdeidæ among the Hydroids was not a natural one. He proposed for the reception of these groups a new division equivalent to the Discophoræ and Hydroids. But as he considers the Ctenophoræ and Hydromedusæ as the two great divisions of the Acalephs, his group of Ægineæ would hold very nearly the same rank as that which we are induced to assign to it here, — that of a suborder among Discophoræ. From the examination of the only species of Campanella thus far found on our coast, and a comparison

with the two species of Trachynema here enumerated, I am inclined to add, near this suborder, two other families, the position of which in the different systems of classification has always been a great puzzle. I mean the Trachynemidæ and the Geryonidæ (Persa, Aglauridæ).* The peculiar solid character of the bell of these families, incapable of contraction to any extent, is in striking contrast with the transparent filmy disk of the true Hydroids, reminding us of the solid mass of the larger Discophoræ. The character of the development, also, which takes place directly from the egg, differs from that of the true Hydroids, and we should thus remove from them those Jelly-fishes which do not pass through an alternate generation. The peculiar character of the marginal appendages of the Trachynemidæ, so different from anything found among the true Hydroids, and which resemble so closely those of the Charybdeidæ, is another character in favor of this division, as well as the nature of the veil, which is a thick, solid, folded membrane, approaching somewhat in character the actinal pouches formed by the veil of Campanella.

Campanella pachyderma A. Agass.

This small Medusa is particularly interesting on account of the light it throws on the systematic position of the Æginidæ. Having the general appearance of the Æginidæ, it has, however, distinctly marked radiating and circular tubes; the genital organs are developed, as in that family, in horseshoe-shaped pouches arranged round the base of the proboscis, which projects through a small space left by the pendent folds of the veil beyond the level of its actinal surface. The circular tube is thus apparently placed at nearly one third of the height of the bell, owing to the great expansion of the eight lobes of the lower floor. The veil is attached at the inner extremity near the genital pouches, and between every two of the chymiferous tubes it is drawn up, forming a distinctly marked indentation. The position of the genital pouches is very similar to what we find among other Discophoræ, as the Lucernariæ and Cuninidæ, for instance, where they form an elongated lobed rosette round the centre. The genital pouches extend in a continuous line round the base of the proboscis. The shape of the bell is a somewhat depressed hemisphere, flaring slightly at the base; the tentacles are carried somewhat stiffly (Fig. 70), and are capable of but limited contraction and expansion; the proboscis equals in length the height of the bell; it is conical, and terminates in a smooth opening. The veil is not very opaque, and when the medusa is seen from the actinal side (Figs. 71, 72), the chymiferous tubes, as well as the circular tube,

* From the figure given by Gegenbaur of the pedunculated marginal bodies in Aglaura, the affinity to Trachynema (Circe) is unquestionable.

can readily be seen through its thickness. The bell itself is of a dirty yellowish color, with dark sorrel-colored spots scattered thickly over its

Fig. 70.

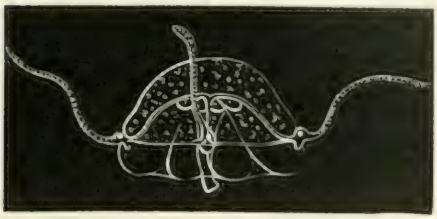
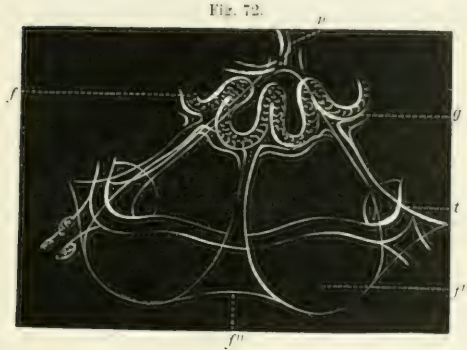


Fig. 71

Fig. 72.



surface; these pigment spots are similar to the little bunches of lasso cells found on the surface of Aurelia. The pouches are capable of

Fig. 73.

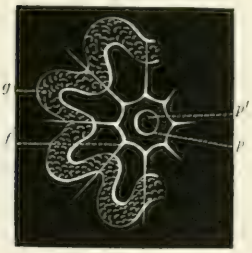


Fig. 74.

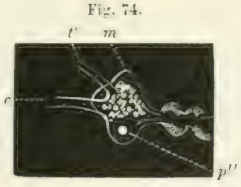
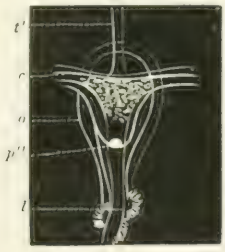


Fig. 75.



expansion and contraction, as it will often be seen that the proboscis has considerable play when the pouches are thrown out beyond the

Fig. 70. Profile view of Campanella.

Fig. 71. Actinal view of Fig. 70; the tentacles are cut off.

Fig. 72 is a somewhat more magnified view of Fig. 71, in which the pouches are thrown out beyond the circular tube. p is the outer wall of the proboscis; g, the genital pouches; f, the place of attachment of the veil, as seen from the actinal side; f', one of the pouches formed by the veil; f'', the part of the veil intermediate between two pouches; t, the base of a tentacle.

Fig. 73 is a view of a part of the actinal surface in the condition of Fig. 71, when the pouches are drawn closely round the proboscis; lettering as in Fig. 72. p', interior of proboscis.

Fig. 74 is a magnified profile view of a portion of the base of a tentacle. c, the circular tube; t', the chymiferous tube; p'', the pigment spot on lower surface of bulb; m, the upper part of sensitive bulb, in which pigment cells are loosely scattered.

Fig. 75. View of basal portion of tentacle, seen from above; lettering as in Fig. 74. l, clusters of lasso cells; o, outer wall of bulb.

margin of the circular tube (Fig. 72), while at other times it is closely hemmed in on all sides. (Fig. 73.) The base of the tentacles swells out above and below the chymiferous tube, forming a large bulb, in the upper portion of which pigment-cells of a brownish-red color (Fig. 73, *m*) are loosely scattered, while in the lower portion (Figs. 74, 75, *p''*) a dark concentrated pigment-spot is found. The tentacles are hollow, and are surrounded for their whole length by clusters of lasso cells (Fig. 75, *l*) similar to those of young Tubularian Medusæ, such as Coryne and Syndiction.

The size of this Medusa is about one twentieth of an inch in diameter.

Found at Nahant, September, Alex. Agassiz.

Museum diagram No. 16, after Alex. Agassiz.

ÆGINOPSIS Br.

Æginopsis Br. (*non* J. Müller). Prod. Mém. Acad. St. Petersburg, p. 222. **1835.**
Æginopsis Agass. Cont. Nat. Hist. U. S., IV. p. 170. 1862.
Æginopsis Less. Zooph. Acal., p. 304. 1843.

Æginopsis Laurentii Br.

Æginopsis Laurentii Br. Mém. Ac. St. Petersb., Pl. 6, p. 363. 1838.
Æginopsis Laurentii Less. Zooph. Acal., p. 304. 1843.
Æginopsis Laurentii Agass. Cont. Nat. Hist. U. S., IV. p. 170. 1862.

Laurent Bay, Behring's Straits (Mertens).

Suborder TRACHYNEMIDÆ A. Agass.

Forbes, in his Natural History of the British Naked-eyed Medusæ, characterized as a family the Circeidæ; at that time only a few other species of this group were known, but so imperfectly described that even at the present day the natural affinities of these Medusæ are far from being well ascertained. Gegenbaur, who has studied Medusæ which I suppose to be only the young of closely allied forms, has also separated his young Medusæ as a distinct family, under the name of Trachynemidæ. The *Dianæa conica* of Lesson may even prove to be the adult of his *Trachynema ciliatum*, as it is evident from the drawing of Lesson* that he has figured there a Medusa closely allied to *Circe* Forbes, and perhaps identical with it. A comparison of *Trachynema ciliatum* (Geg. Pl. IX. Fig. 6) with the young specimens of Circe here figured, will show the close affinity of these two Medusæ. The family name of Trachynemidæ ought therefore yield to that proposed

* Ann. Scien. Nat., Vol. X. Pl. 6, Fig. 3.

by Forbes; unfortunately, the name Circe had already been applied to a genus of Mollusks, before Brandt proposed it in 1838, and we have therefore retained the name of Gegenbaur. Gegenbaur placed these Medusæ in the vicinity of the Eucopidæ; but a close examination of their characters, to which I have already referred when speaking of Campanella, leads us to remove them — as well as the Aglauridæ, Geryonidæ, and Leuckartidæ — to the Discophoræ Haplostomeæ, as a separate suborder closely allied to the Æginidæ. Dr. Fritz Müller, to whom I had suggested the probability of Circe being the adult of Trachynema, says, in one of his letters, that he has found Trachynema near Desterro; "in consequence of this, it is highly probable that they are the young of Tamoia, never having met with Circe on our coast." If this should prove to be the case, we have a very strong argument in favor of joining the Trachynemidæ (Circeans) with the Discophoræ.

Family TRACHYNEMIDÆ Gegenb.

Trachynemidæ Gegenb. Zeit. f. Wiss. Zool., VIII. p. 249. 1856.
Circeidæ Forbes. Brit. Naked-eyed Medusæ, p. 34. 1848.
Circeidæ Agass. Cont. Nat. Hist. U. S., IV. p. 348. 1862.
Trachynemidæ Agass. Cont. Nat. Hist. U. S., IV. p. 365. 1862.

TRACHYNEMA Gegenb.

Trachynema Gegenb. Generationswechsel, p. 50. 1854.
Circe Mertens. Br. Mém. Acad. St. Petersb., p. 219. 1835. (Preoccupied in Moll.)
Circe Forbes. Brit. Nak. Medusæ, p. 34. 1848.
Circe Less. Zooph. Acal., p. 285. 1843.
Circe Agass. Cont. Nat. Hist. U. S., IV. p. 348. 1862.

Trachynema camtschaticum A. Agass.

Circe camtschatica Br. Mém. Acad. St. Pet., p. 354, Pl. I. Figs. 1–5. 1838.
Circe camtschatica Agass. Cont. Nat. Hist. U. S., IV. p. 348. 1862.
Circe camtschatica Less. Zooph. Acal., p. 285. 1843.
Circe impatiens Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.

A few specimens of this beautiful little jelly-fish (Fig. 76) were caught on the shores of Galiano Island, in the Gulf of Georgia, W. T. The greatest diameter is situated on a level with the point of suspension of the ovaries. The ovaries are flat, triangular-shaped (Fig. 77), the chymiferous tubes very slender. The solid prolongation of the abactinal portion of the spherosome, which extends, in the Eastern species, to a short distance of the actinostome, is much shorter (Fig. 78); the chymiferous cavity is especially long, and extends to the

actinal pole in the ordinary state of expansion (Figs. 76, 79); it is only slightly contractile, and terminates in four stout lappets. (Fig. 80.) The outline of the abactinal portion of the spherosome is conical, with two very slight curves, one immediately above the point where the

Fig. 76.

Fig. 77.

Fig. 79.

Fig. 78.

chymiferous tubes turn towards the actinal pole, along the solid prolongation of the spheromere, and the other nearer the abactinal pole. The outline of the spherosome bends very suddenly towards the abactinal pole immediately above the point of attachment of the ovaries, somewhat as we have it in younger specimens of Trachynema. The number of spheromeres is eight, and that of the oral appendages four. The ambulacral tentacles (40 to 48) are rather contractile, and when contracted appear as if they had been knotted. The general color is very pale pink; the ovaries, ambulacral tentacles, and the proboscis being of a light-brown color. Although generally this medusa moves very slowly, when disturbed its movements are very rapid; and instead of continuing in the same direction, the animal draws all its tentacles inside of the actinal veil, and then suddenly throws them out again, this contraction turning the medusa almost upside down, and starts off in nearly the opposite direction from that which it had previously pursued. This species was only seen during a short time in July.

Fig. 80.

The drawing of Brandt seems to have misled Forbes; he speaks of the want of ocelli of the British species as distinguishing it from the *C. camtschatica;* what Forbes has taken for ocelli are only sections of the chymiferous tubes leading into the peripheric tube.

Kamtschatka (Mertens); Galiano Island, Gulf of Georgia, W. T. (Alex. Agassiz).

Cat. No. 282, Gulf of Georgia, W. T., 1859, A. Agassiz.

Fig. 76. Profile view of Trachynema camtschaticum, slightly magnified.

Fig. 77. One of the genital organs. *g*, point of attachment to chymiferous tube.

Fig. 78. Section of Trachynema to show the size of the gelatinous prolongation, *p*, and the mode of attachment of the genital organs, *g*.

Fig. 79. Chymiferous cavity of Trachynema at the end of the gelatinous proboscis.

Fig. 80. View of Trachynema from above, to show the shape of the lips of the actinostome. *c*, chymiferous cavity at base of proboscis into which the tubes lead; *p*, gelatinous part of proboscis; *l*, lips of actinostome; *o*, opening formed by contraction of part of the chymiferous cavity.

Trachynema digitale A. Agass.

Medusa digitalis Fab. Faun. Groenl. No. 361. 1780.
Turris (*Circe*) *digitalis* Mörch (*non* Forbes). Besk. af Grönl., p. 95. 1857.
Eirene digitale Esch. Syst. der Acal., p. 95. 1829.

There is considerable doubt as to the specific difference of this species of Trachynema from the English Circe of Forbes, and from the *Circe camtschatica* of Brandt, the series of young observed at Nahant being the only one which gives us any measure of the changes one species undergoes during its growth. It is evident from the figure of Forbes that the genital organs are but slightly developed; in the north-

Fig. 81.

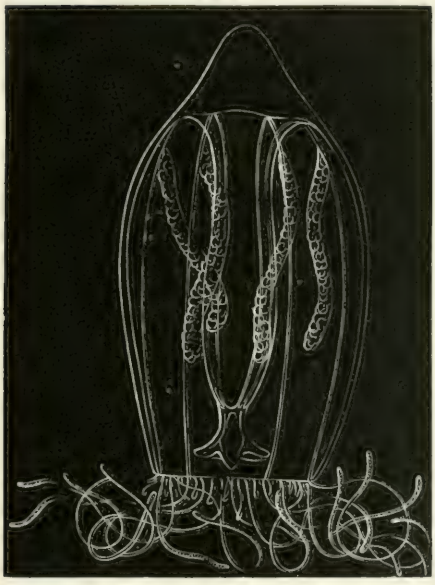


Fig. 82.

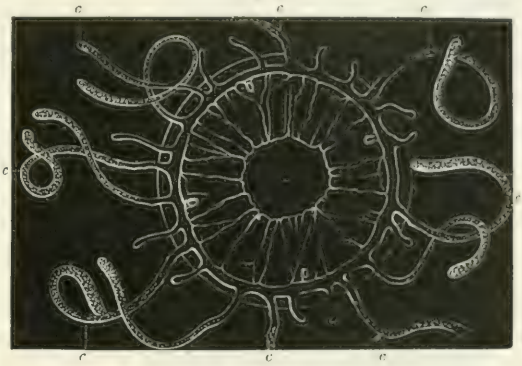
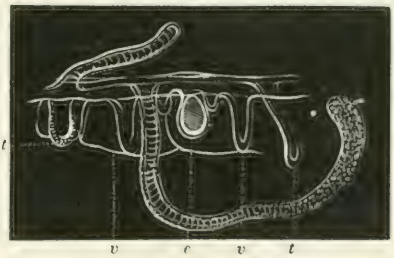


Fig. 83.



western species the only specimens observed were all males, while the only adults of this species obtained on our coast were females. This question must be left undecided until we have a complete history of the English species.

The adult medusa (Fig. 81) is characterized by the thinness of the bell, the great size of the gelatinous proboscis, which extends nearly to

Fig. 81. Adult female Trachynema, seen in profile; magnified.

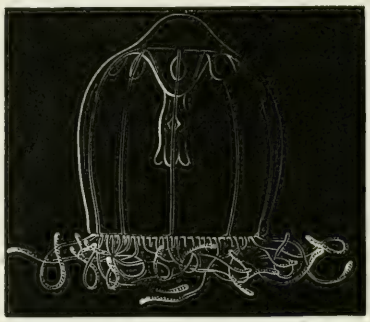
Fig. 82. Actinal view of the veil and circular tube of a very young Trachynema. *c*, *c*, *c*, *c*, tentacles opposite the chymiferous tubes; greatly magnified.

Fig. 83. Profile view of a part of the circular tube to show the folds of the veil. *e*, one of the pedunculated marginal capsules; *t*, young tentacle; *v*, folds of the veil; somewhat more magnified than Fig. 82.

the level of the circular tube, and the small size of the digestive cavity. The eight chymiferous tubes are broad, and their course can readily be traced along the proboscis. The summit of the bell is quite conical; the chymiferous tubes lead into a broad circular tube, opening into the tentacles, which are hollow; the tentacles appear to be easily lost, as it is rare to obtain adult specimens in which we find anything more than mere stumps in the place of tentacles. I have been unable on this account to ascertain the normal number of tentacles in the adult; they never seem to become very numerous. (See Fig. 81.) A tentacle is placed opposite the base of each chymiferous tube, *c*, *c*, *c*, . . Fig. 82, being a view from the actinal side of the youngest Circe observed; between the chymiferous tubes there are in these young Medusæ two other tentacles. We find also four marginal capsules in the young as well as the adult; their number does not increase with age. The capsules are large, ellipsoidal, garnet-colored bodies, enclosed in a fold, standing out from the circular tube as if attached by a short peduncle. (*e*, Fig. 83.) The veil is thick, snugly folded at the inner margin (Fig. 82), the larger folds extending to the circular tube. Owing to the slight contractility of the bell of these Medusæ, they use the veil as

Fig. 84.

Fig. 85.



their principal means of propulsion, bending it into the cavity of the bell, and then throwing it out with great force (see Fig. 86); we have nothing of the graceful motions of the gelatinous disk, so characteristic of the Hydroid Medusæ. In an adult, when seen in profile, the folds of the veil are so thick that they are easily mistaken for rudimentary tentacles (*v*, *v*, Fig. 83); it is only when we see the veil turned in, or expanded fully outside of the bell, that their true nature is understood. In adult females, the cavity of the bell is almost filled by the eight sausage-like ovaries which hang down from near the upper part of the chymiferous tubes, almost to the extremity of the gelatinous proboscis. (Fig. 81.) They are of a milky color, the bell is of a slightly pinkish tint; far from being transparent, it has a horny look, and be-

Fig. 84. Profile view of a young Trachynema, about one eighth of an inch in height.
Fig. 85. Trachynema somewhat more advanced than Fig. 84.

comes wrinkled between the chymiferous tubes; the tentacles, when contracted, become crimson at the extremity.

The young Medusæ are very different in shape from the adults. Small specimens, measuring not quite an eighth of an inch in height (Fig. 84), are quite globular; they have but few tentacles (Fig. 82), the ovaries are not developed, the gelatinous proboscis is a mere knob at the bottom of the bell, from which hangs down quite a long digestive cavity. The abactinal part of the bell projects but slightly beyond the general outline. It is in this stage that it resembles so closely the *Trachynema ciliatum* of Gegenbaur. When disturbed, they carry the lips of the actinostome turned up, in a very characteristic manner, as Gegenbaur has figured them. In somewhat older specimens (Fig. 85) the bell has become more elongated, the tentacles more numerous, the ovaries make their appearance as small pouches, as in Eucope, and the gelatinous proboscis has extended somewhat into the cavity of the bell. In still older forms (Fig. 86) these parts have all taken a more prominent development, and we readily recognize, in the somewhat elongated bell, with the large proboscis and slightly pendent ovaries, the future adult Trachynema (Fig. 81), in which the development of the gelatinous proboscis, of the ovaries, of the tentacles, the lengthening of the bell, and its increase in thickness at the abactinal extremity, have been carried still further. The adult medusæ attain a height of an inch or an inch and a half.

Fig. 86.

I have identified this Medusa with the *Medusa digitalis* of Fabricius. Forbes had, in his Naked-eyed Medusæ, supposed a species of Turris to be identical with it; after a careful perusal of the description of Fabricius, I am satisfied that it does not belong to the genus Turris, but to Circe of Brandt, or Trachynema of Gegenbaur. Mörch, in his List of Medusæ of Greenland, retains the generic name of Forbes, and makes it synonymous with Circe; this is certainly a very different interpretation of the genus Turris of Lesson from what it has received thus far by any writer on Acalephs.

Baffin's Bay (Fabricius); Massachusetts Bay, Nahant (Alex. Agassiz).

Cat. No. 376, Nahant, Mass., A. Agassiz. Medusæ.

Cat. No. 377, Nahant, Mass., A. Agassiz. Medusæ.

Cat. No. 449, Nahant, Mass., A. Agassiz. Medusæ.

Museum diagram Nos. 16, after Alex. Agassiz.

Fig. 86. Young Trachynema, measuring over one third of an inch in height; the veil is thrown out beyond the level of the circular tube.

PERSA McCr.

Persa McCr. Gymn. Charl. Harb. 1857.
Persa Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.

Persa incolorata McCr.

Persa incolorata McCr. Gymn. Charl. Harb., p. 104, Pl. 12, Fig. 3. 1857.
Persa incolorata Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.

Charleston Harbor (McCrady).

Family LEUCKARTIDÆ Agass.

Leuckartidæ Agass. Cont. Nat. Hist. U. S., IV. p. 364. 1862.
Geryonidæ Esch. (*p. p.*). Syst. d. Acal., p. 86. 1829.

LIRIOPE Gegenb.

Liriope Gegenb. (*non* Less.). Zeit. f. W. Zool., p. 256. 1856.
Geryonia Less. Zooph. Acal., p. 329. 1843.
Geryonia Esch. (*p. p.*). Syst. d. Acal., 1829. (*Non* Pér. et Les.)
Dianæa Q. and G. Voyage de l'Uranie, p. 566.
Eurybia Esch. Syst. d. Acal., p. 118. 1829. Young?
Eurybiopsis Gegenb. Zeit. f. Wiss. Zool., p. 247. 1856.
Liriope Agass. Cont. Nat. Hist. U. S., IV. p. 365. 1862.

Liriope tenuirostris Agass.

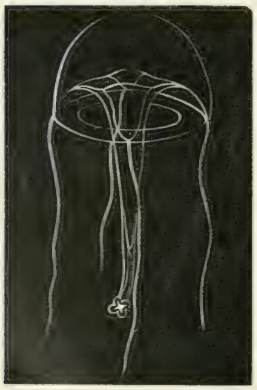
Liriope tenuirostris Agass. Cont. Nat. Hist. U. S., Vol. IV. p. 365. 1862.

Florida, Key West (L. Agassiz).

Liriope scutigera McCr.

Liriope scutigera McCr. Gymn. Charl. Harb., p. 106.
Liriope scutigera Agass. Cont. Nat. Hist. U. S., IV. p. 365. 1862.

Fig. 87.



In company with *Liriope tenuirostris* is found another species of Liriope (Fig. 87), which may prove identical with the *Liriope scutigera* of McCrady, although it differs in the shape of the ovaries, which are more heart-shaped than he describes. The description of McCrady agrees better with the figure of *Liriope catherinensis* of Fritz Müller, with which it may prove identical.

Charleston, S. C. (McCrady).

Fig. 87. Liriope scutigera McCr.?

Suborder LUCERNARIÆ Johnst.

Lucernariadæ Johnst. (*non* Huxl.). Brit. Zooph., p. 244, Second Edition.
Calycozoa Leuck. Morphol. u. Verwandtschaft der Wirbell. Thiere, p. 20. 1848.
Podactinaria Edw. and Haime. Brit. Foss. Corals. 1850.
Lucernariadæ Agass. Cont. Nat. Hist. U. S., IV. p. 175. 1862.
Lucernariæ H. J. Clark. Proc. Bost. Soc. Nat. Hist., p. 47. 1862.
Lucernariæ H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 531. 1863.

Clark has made of the Lucernariæ an order equivalent to the Hydroids and the Discophoræ; but it should be remembered at the same time that his Acalephæ correspond to the Hydroid and Discophorous Medusæ of other authors, and do not include the Ctenophoræ. We would reduce this group to the level of a suborder; for, as Professor Agassiz has very justly said, the Lucernariæ are only pedunculated Discophoræ, and have no claim to be considered as a group of a higher value than a suborder. They seem to bear the same relation to the free Discophoræ which the Pentacrinidæ do to the Comatulidæ. Their mode of development may show that their separation as a distinct suborder is giving even too much weight to their embryonic character; and we may find, with future investigations, a somewhat similar relation between them and the Strobila, from which free Discophoræ are produced, as that which we have between the free and sessile species of Tubularians.

Family CLEISTOCARPIDÆ H. J. Clark.

Cleistocarpidæ H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 535. 1863.

HALIMOCYATHUS H. J. Clark.

Halimocyathus H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 536. 1863.

Halimocyathus platypus H. J. Clark.

Halimocyathus platypus H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 537.

Chelsea Beach, Mass. (H. J. Clark).

MANANIA H. J. Clark.

Manania H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 541. 1863.

Manania auricula H. J. Clark.

Manania auricula H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 542. 1862.
Lucernaria auricula Fab. (*non* Müll.). Fauna Groenl., 1780, No. 332.
Lucernaria typica Greene. Nat. Hist. Rev., p. 132. 1858.
Lucernaria Fabricii Agass. Cont. Nat. Hist. U. S., IV. p. 176. 1862.

I give here only the principal synonymes. For the remaining synonymes of this and other species of Lucernariæ, I would refer to the papers of Professor Clark.

Swampscott (Agassiz); Greenland (Fabricius); Eastport, Maine (W. Stimpson).

Family ELEUTHEROCARPIDÆ H. J. Clark.

Eleutherocarpidæ H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 536. 1863.

LUCERNARIA Müll.

Lucernaria Müll. Prod. Zool. Dan. 1776.
Lucernaria Agass. (*p. p.*). Cont. Nat. Hist. U. S., IV. p. 175. 1862.
Lucernaria H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 551. 1863.

Lucernaria quadricornis Müll.

Lucernaria quadricornis Müll. Zool. Dan., I. p. 51, Pl. 39, Figs. 1–6.
Lucernaria quadricornis Sars. Fauna Littor., p. 20, Pl. 3, Figs. 1–7.
Lucernaria quadricornis Johnst. Br. Zooph., p. 252, Pl. 15, Figs. 3–7.
Lucernaria fascicularis Flem. Wern. Soc., II. p. 248.
Lucernaria quadricornis Agass. Cont. Nat. Hist. U. S., IV. p. 175. 1862.
Lucernaria quadricornis Stimps. Mar. Inv. Grand Manan, p. 8. 1853.
Lucernaria quadricornis H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 551. 1863.
Lucernaria quadricornis Edw. & Haime. Hist. des Cor., III. p. 459.

Grand Manan (W. Stimpson); Massachusetts Bay, Chelsea Beach, and Swampscott (Dr. A. A. Gould and L. Agassiz); Greenland (Fabricius).

Cat. No. 324, Owl's Head, Maine, W. Stimpson.

Museum diagram No. 14, after L. Agassiz.

HALICLYSTUS H. J. Clark.

Haliclystus H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 559. 1863.

Haliclystus auricula H. J. Clark.

Haliclystus auricula H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 559. 1863.
Lucernaria auricula Müll. Zool. Dan., Pl. 152.
Lucernaria auricula Mont. Lin. Trans., IX. Pl. 7, Fig. 5.
Lucernaria auricula Johnst. Br. Zooph., p. 246, Second Edition.
Lucernaria auricula Sars. Bidr. Söe. dyr., Pl. 4, Fig. 1–13.
Lucernaria octoradiata Lamk. An. s. Vert., II. p. 414. 1816.
Lucernaria auricula Edw. & Haime. Hist. d. Coralli, III. p. 458.
Lucernaria auricula Agass. Cont. Nat. Hist. U. S., IV. p. 176. 1862.
Haliclystus auricula Pack. List of Animals. 1863.

Without attempting a critical revision of the Lucernariæ, which has become necessary in consequence of the somewhat contradictory statements of Sars, Edwards, Allman, Gosse, Keferstein, and Clark, and for which the materials in the Museum do not afford sufficient data, I have adopted the generic names of Clark, as it is plain, from what was already suggested by M. Edwards, that the Lucernaridæ do not belong to a single genus, but that several genera can very justly be distinguished upon the single genus of Lucernaria of previous authors.

Fig. 88

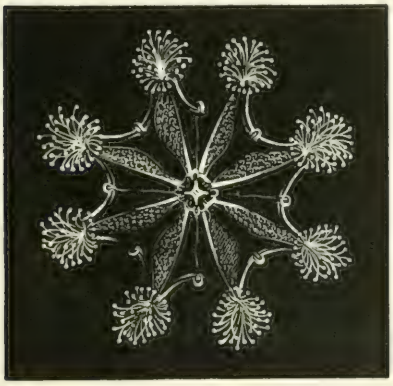


Fig. 89.

The figures here introduced are of our common Lucernaria (Figs. 88, 89), and will give a tolerable idea of the varied attitudes they assume. This species is quite common, found attached to eel-grass. For a further knowledge of this group of Acalephs, I would refer to the original papers quoted above.

Fig. 90.

The young of our Lucernaria (Fig. 90) shows how much still remains to be done respecting the changes which it undergoes. In a small Lucernaria, of one

Fig. 88. Haliclystus auricula, seen from the actinal pole.

Fig. 89. Different attitudes of Lucernaria, of Fig. 88, attached to sea-weed, contracted, expanded, or with the disk thrown back, and the actinostome projecting like a proboscis. These figures are of natural size.

Fig. 90. Young Lucernaria, magnified, about one tenth of an inch in height. *a*, anchors still retaining the shape of the tentacles, *t*.

tenth of an inch in height, the arrangement of the tentacles is totally different from that of the adult. They are as yet not arranged in clusters, but placed at regular intervals in one line on the edge of the disk. No difference can at present be detected between the anchors (*a*, Fig. 90) and the tentacles (*t*, Fig. 90) of the disk, showing plainly that the anchors, as Professor Clark has proved, are only modified tentacles; the peduncle is also quite short, and stout in proportion to the disk. The young Lucernaria is in this state a close representative of the genus Carduella of Allman, which may possibly prove to be only the young of some European species.

Greenland (Steenstrup); Anticosti (Verrill, Shaler, and Hyatt); Massachusetts Bay (H. J. Clark).

Cat. No. 320, Nahant, Mass., A. Agassiz, May, 1862.

Cat. No. 321, Chelsea Beach, L. Agassiz.

Cat. No. 322, Mount Desert Islands, Maine, W. Stimpson.

Cat. No. 323, Anticosti Island, Anticosti Expedition, August, 1861.

Cat. No. 380, Anticosti Island, Anticosti Expedition, August, 1861.

Haliclystus salpinx H. J. Clark.

Haliclystus salpinx H. J. Clark. Journ. Bost. Soc. Nat. Hist., p. 563. 1863.

Mount Desert Islands, Maine (Stimpson).

Order HYDROIDÆ Johnst. (*mod.* Agass.).

Anthozoa Hydroida Johnst. Brit. Zooph., Second Edition, p. 5.
Gymnophthalma Forbes. Brit. Naked-eyed Medusæ. 1848.
Coralliaria Tabulata, *Rugosa*, and *Hydraria* Milne Edw. & Haime.
Hydromedusæ et *Siphonophoræ* Vogt. Siph. de Nice.
Hydroidea, *Medusida Craspedota*, and *Siphonophora* Gegenb. Zeit. f. W. Zool. 1856.
Hydroidæ McCr. (*p. p.*). Proc. Elliot Soc. 1857.
Hydrozoa Huxl. Ray Soc. 1859.
Hydroidæ Agass. Cont. Nat. Hist. U. S., III. 1860. IV. p. 337.

From want of materials, no writer on Acalephs has thus far attempted to make use of the embryological characters noticed in the development of young Hydroid Medusæ and of the young Hydraria. From the observations of Wright on the development of *Thaumantias inconspicua*, of Æquorea, and from what I have had occasion to observe myself on the Hydroid of Melicertum and of Tima, we have acquired sufficient information to satisfy ourselves that Tubularian-like Hydroids stand lower than the Campanularians; while such forms as the Hydroids of

Melicertum, of Trichyra, and Lafœa, stand intermediate between them. Resembling the youngest stages of the Campanularian Hydrarium we have such forms as Clava and Rhyzogeton; while the more branching forms, Eudendrium and Bougainvillia, remind us already of somewhat older stages. Lower still we must place Hydractinia, where the polymorphism of the individuals is an evident sign of inferiority, reminding us of the free communities formerly separated from the Hydroids as Siphonophores. From the close resemblance of the animal of the Tabulata to such forms as Halocharis and the fresh-water Hydra, we must consider them as an order, or perhaps only a suborder standing in close relation to the Tubularians. Unsatisfactory as this may seem, these few facts throw much light on our knowledge of the relations of the Hydroids. Somewhat more satisfactory and more general results can be obtained by comparing the young Medusæ in their various stages of growth. As I have already shown, in a short paper on the order of appearance of the tentacles of Hydroid Medusæ, the young, when liberated, undergo great changes before arriving at their mature condition; and it requires a thorough knowledge of all these changes to be able to recognize one and the same species in its various stages of growth, and not to divide, as has been done so far, different species by the number of tentacles, of marginal bodies, or the size of the ovaries. The main characteristic of the greater number of Tubularians, when first liberated, is the totally different shape of the bell from that of the adult. The bell is very deep, the number of tentacles is small (Turritopsis, Bougainvillia, and Nemopsis); in the adult the shape of the bell has become quite globular, the tentacles have increased in number, the ovaries, which are generally absent or but slightly developed in the young Medusæ, have taken a development corresponding to their age. Applying this to the standing of the different Tubularians, we should place genera such as Clava and Eudendrium, in which the Medusæ are always sessile, lowest in their families; next, the old genus Tubularia, such as Tubularia proper, next Corymorpha, Hybocodon, then Ectopleura, where we find the Medusæ losing almost entirely their embryonic character. From these we pass to Sarsia, Syndictyon, Dipurena, Saphenia, Turris, and Turritopsis. We then have families where the localization of the tentacles, the position of the ovaries along the proboscis, and partly along the chymiferous tubes, is a character of superiority, such as Dysmorphosa, Lizzia, Bougainvillia, and Nemopsis, having a limited number of tentacles placed at stated points along the circular tube. Closely allied to these are such more Campanularian-like forms, as Melicertum, Ptychogenia, and Staurophora, where the number of tentacles is large, but which want the peculiar marginal bodies so characteristic of Campanularian Medusæ, and where the genital organs are intimately connected with the digestive cavity. The young of these Medusæ (Melicertum and

Staurophora) have, like the young Tubularian Medusæ, a deep bell and few tentacles; these characters they lose with advancing age. The young Medusæ of the greater part of the Campanularian Hydroids, with the exception of the Eucopidæ and some of the Æquoridæ, also have, immediately after they are liberated, a form totally unlike that which they eventually assume. A young Clytia or Oceania has a deep bell, only a couple of long tentacles, and few marginal capsules, having a totally different arrangement from what we find in the adult. With advancing age, the tentacles and marginal bodies increase in number, the disk becomes flattened, and ovaries make their appearance along the chymiferous tubes. In the Eucopidæ the number of tentacles with which the young Medusæ are liberated is far greater, the marginal capsules being constant in young and old. The same is the case with the Æquoridæ; they are liberated with many tentacles, and the disk, like that of the Eucopidæ, is quite flat. We find also among the Campanularians, in some genera, a tendency to localization of the tentacles, as in Eucheilota; or to great complexity of the marginal capsules, as in Tima and Tiaropsis; and finally a great development of the gelatinous proboscis, as in Eutima, Geryonia, and Tima. The gelatinous prolongation of the disk we must regard as an embryonic feature; the great number of chymiferous tubes is likewise a character of inferiority; so that we would place lowest among the Campanularians the Geryonopsidæ, all these having tolerably deep bells and few tentacles, more resembling the Tubularians; next the Æquoridæ, some of which, in their young stages (Halopsis), resemble the Medusæ of Tubularians, with their high bell and few tentacles; next would come the Eucopidæ, having still a large number of tentacles, but where the marginal capsules are limited in number, and in which the young Medusæ at no time resemble the young Medusæ of Tubularians; finally, highest of all the Campanularians would stand the Oceanidæ, where the number of tentacles is not very great, and the complication as well as localization of the marginal capsules is very definite. The ovaries likewise guide us somewhat in this classification; they extend along the proboscis and chymiferous tubes in Tima and the Geryonopsidæ; in the Æquoridæ they take their origin from the base of the digestive cavity; in the Eucopidæ they are limited, as well as in the Oceanidæ, to definite parts of the chymiferous tubes.

Were we to judge simply from the nature of the Medusæ of the so-called Siphonophoræ, the swimming bells and the sexual Medusæ, we should be justified in uniting them with the same order as Hydroids, making, of the different orders which had been proposed before, only suborders of the great order of Hydroids, and thus not recognizing the class of Siphonophoræ, as recently modified by some naturalists. There is perhaps no stronger case to be brought up in confirmation of this view, than the fact that the free Medusæ of Velella are so closely allied

to the Medusæ of some of our Tubularians, that McCrady even proposed to separate the Velellidæ from the Siphonophoræ, and to place them next the Tubularians; the sexual Medusæ, also, of several of these free Hydroids resemble very closely other Medusæ, as those of Hybocodon, Corymorpha, and the like. When we add to this the strong argument derived from the homology of the development of the Hydroids, whether free or floating, as is shown hereafter from Nanomia, we can have but little hesitation in acknowledging the value of the order of Hydroids as first limited by Professor Agassiz, and the return, as proposed by him, to the old subdivisions of Eschscholtz, the great master in the classification of the Acalephæ, whose views seem to stand out brighter with every fresh investigation. For certainly the subdivision by Leuckart of the Siphonophoræ into two suborders, and the uniting of Physalia and Porpita and the like into one order with Agalma and its allies, is a disregard of the true value of the ordinal characters which are to be found in the combination of the float with the rest of the community, such as we find developed in the three great phases of embryonic growth of a Physophore. (See Nanomia.) As to the true position of the different orders of the old group of Siphonophoræ among the Hydroids, we cannot fail to consider them as lowest in the series; they form communities, the different individuals of which never attain the high degree of complication and the individuality so characteristic of the Campanularian Medusæ, and they must therefore rank lowest, next to Hydractinia and the like, which form the connecting link between them and the truly fixed Hydroids.

In the limitation of the families of Hydroids, it is very difficult to draw any line of demarcation, whenever we attempt to separate, as distinct families, those Medusæ which are always sessile, from those which lead an independent existence. The close affinity existing between the Hydroids of genera in which we have free and sessile Medusæ, seems to preclude the idea of separating them as distinct families, notwithstanding the great difference of form between the adult Medusæ. As our knowledge of the embryology of Hydroids becomes more extended, cases occur more frequently in which Hydroids, so closely allied that it is difficult to distinguish them generically, unless it be in the breeding season, produce Medusæ which are either sessile, or lead an independent existence; for instance, the many species of Campanularians closely allied to Laomedea, the Tubularians of the genus Tubularia, and the different species formerly referred to Eudendrium. We must combine, as far as we are able from existing information, our knowledge of the Medusa and of the Hydrarium; this seems the only rational method, and one which has already lead those who have adopted it to very important relations of the true affinities of Acalephæ. This view of the proper method to be followed in the classification of Hydroids has been frequently em-

ployed by Agassiz, Leuckart, and Vogt. Sars, in his paper on Corymorpha, has developed it fully, quoting many instances in support of this theory. Allman, in a recent paper on the Classification of Hydroids, has carried the same method out for the Tubularians.

Suborder SERTULARIÆ Agass.

Sertulariæ Agass. Cont. Nat. Hist. U. S., IV. p. 348. 1862.
Sertularina Ehrenb. Corall. des roth. Meeres.
Sertularina Johnst. Brit. Zooph., p. 56.

Family OCEANIDÆ Esch. (*rest.* Ag.).

Oceanidæ Esch. Syst. d. Acal., p. 96. 1829.
Eucopidæ Gegenb. (*p. p.*). Versuch eines Syst. d. Med., p. 241. 1856.
Oceanidæ Agass. Cont. Nat. Hist. U. S., IV. p. 352. 1862.

The free Medusæ which belong to this family are characterized in their adult condition by the flatness of the bell, and its thinness, long, hollow tentacles, not very numerous, four chymiferous tubes, marginal capsules, and a short proboscis. The Hydrarium is remarkable for its ringed or pedunculated reproductive calycles.

The genus Thaumantias, until the time of Forbes, contained in it Medusæ belonging to several genera. Forbes first proposed to divide it, and suggested the name Cosmetira for his *Thaumantias pilosella*. Gegenbaur, in 1856, proposed another name, that of Eucope, which included several species of the genus Thaumantias, belonging to a different family, the Eucopidæ.

As long as the numerous species of Thaumantias, described by Forbes, have not been investigated again with special reference to the marginal capsules, it is impossible to assign many of them their true position in the genera Eucope, Oceania, and Laodicea, which have been distinguished in these Acalephs. It seems to me doubtful whether the genus Epenthesis of McCrady can be retained, and I think it will eventually prove identical with Oceania, if we limit the genus to such species as *Thaumantias hemisphærica* of Forbes. The Hydra of Oceania is a Wrightia; that of the *Eucope diaphana* of our coast is a Laomedea, resembling the *L. geniculata* of England. The genus Eucope of Gegenbaur would be limited to those species which have small ovaries, occupying but a short space of the chymiferous tubes; and instead of having the long, thin, and exceedingly contractile tentacles of Oceania, have short, stout, knotty tentacles, which are carried straight from the edge of the disk, are hardly contractile, and have a prolongation inside of the circular tube.

TIAROPSIS Agass.

Tiaropsis Agass. Mem. Am. Acad., IV. p. 289. 1849.
Tiaropsis Agass. Cont. Nat. Hist. U. S., IV. p. 355. 1862.

Tiaropsis diademata Agass.

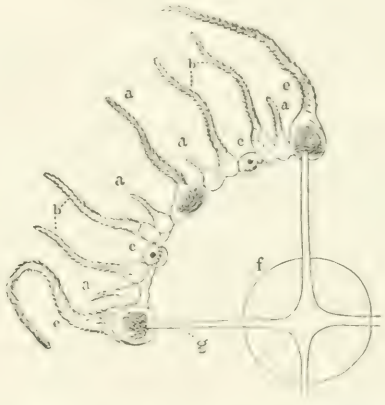
Tiaropsis diademata Agass. Mem. Am. Acad., IV. p. 289, Pl. 6.
Tiaropsis diademata Agass. Cont. Nat. Hist. U. S., III. p. 354, Pl. 31, Figs. 9–15; IV. pp. 308–311, Figs. 45–48. 1862.
Tiaropsis diademata A. Agass. Proc. Bost. Soc. Nat. Hist., IX. p. 93, Fig. 10.
Tiaropsis diademata Mörch.; in Beskriv. af Groenland. 1857.

This Medusa is one of the earliest visitants of our wharves in the spring. In company with Sarsia and Syndictyon, it occurs in great numbers during the spring months; it attains its full size in a comparatively short period (Fig. 91), spawns during April and May, and after that it is found but rarely, disappearing totally during the summer. Although so common, the Hydroid of this Medusa has not been observed. Young Medusæ (Fig. 92), which are fully described in Pro-

Fig. 91.

Fig. 92.

Fig. 93.



fessor Agassiz's Contributions, are exceedingly numerous. The tentacles develop independently of the eyes, while the latter never increase in number. (See Fig. 93.) For a more detailed description of their mode of growth, see also my paper on the marginal tentacles of Hydroids.

The *Thaumantias Pattersonii* of Greene seems to me, as far as I can make out from his description and figures, to belong to the genus Tiaropsis. There must be some error in his view from above, in which he represents black ocelli at the base of the chymiferous tubes: I doubt if

Fig. 91. Tiaropsis diademata, natural size.
Fig. 92. Young Tiaropsis, having twenty-four tentacles.
Fig. 93. Young Tiaropsis, having forty tentacles. *c*, eye-speck; *f*, digestive cavity; *g*, chymiferous tube; *e*, primary tentacles; *a*, middle tentacle; *b*, third set of tentacles in pairs; *a*, fourth and fifth sets of pairs of tentacles.

this is really the case, as we have nothing of the sort among any of the other Hydroid Medusæ.

Massachusetts Bay (Agassiz).

Cat. No. 266, Boston, April, 1862, A. Agassiz. Medusa.
Cat. No. 267, Boston, May, 1862, A. Agassiz. Medusa.
Cat. No. 358, Boston, May, 1862, H. J. Clark. Medusa.

OCEANIA Pér. et Les.

Oceania Pér. et Les. Ann. du Mus., XIV. p. 32. 1809.
Thaumantias Esch. Syst. d. Acal., p. 79. 1829.
Oceania Less. Zooph. Acal., p. 318. 1843.
Phialidium Leuck. Arch. f. Nat., I. 1856.
Epenthesis McCr. Gymn. Charl. Harb., p. 89.
Oceania Agass. Cont. Nat. Hist. U. S., IV. p. 352. 1862.
Wrightia Agass. Cont. Nat. Hist. U. S., IV. p. 354. 1862. Hydrarium.

Oceania folleata Agass.

Oceania folleata Agass. Cont. Nat. Hist. U. S., IV. p. 353. 1862.
Epenthesis folleata McCr. Gymn. Charl. Harb., p. 89.

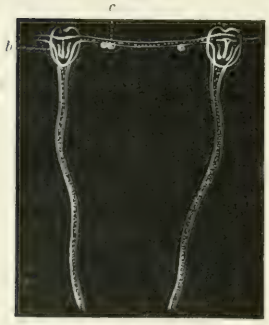
Charleston Harbor (McCrady).

Oceania languida A. Agass.

Oceania languida A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 353. 1862.
Hydrarium. The American species of *Wrightia* mentioned in a note by Professor Agassiz, in Cont. Nat. Hist. U. S., IV. p. 354. 1862.
? Campanularia syringa Stimps. Mar. Inv. Grand Manan, p. 8. 1853.

It must remain doubtful whether this species is not the *Epenthesis folleata* McCr. found in Charleston Harbor. McCrady observed only a single specimen, and his description is too short not to leave some doubt on this point. His single specimen, moreover, was not in a normal condition, as he says there were five labial appendages. From the fact that there is but one marginal capsule between each tentacle in the Charleston species, and rarely two, while there are always two, and frequently three, in the specimens taken on our coast, I would infer that they are distinct species.

Fig. 94.



The capsules are small, and contain only one large granule. The bulbs at the base of the tentacles (*b*, Fig. 94) are large swellings, colored with dark pigment-cells; the tentacles are thread-like, very extensible, with lasso-cells scattered

Fig. 94. Two marginal tentacles, with a portion of the circular tube. *c*, one of the marginal capsules in process of division; *b*, sensitive bulb of tentacle.

irregularly all over the surface; the walls of the tentacles are thin, leaving a wide tube running to their extremity; the labial folds of the short digestive cavity are simple, the edges not being fringed (*f*, Fig. 95); the bell is perfectly transparent and exceedingly thin, remaining of the same thickness close to the edge; the veil is of medium size. The ovaries and the base of the digestive cavity are light brown; the base of the tentacles is somewhat darker. The number of tentacles is from thirty-two to forty; the Medusa measures from three fourths to seven eighths of an inch in size. The marginal capsules are formed by division, a small portion of the capsule being separated by a constriction, and a granule developed in it (*c*, Fig. 94) forms the new capsule, which gradually becomes more and more distinct in older specimens.

Fig. 95.

The observations of Wright on *Laomedea acuminata*, combined with the development given here of a Medusa (Fig. 96) similar to the one he observed, give us the complete history of the genus Oceania. It is particularly important on account of the light it throws on the probable identity of many of the species described by Forbes under the name of Thaumantias, and which are distinguished by the greater or smaller number of tentacles, and the position and size of the ovaries. Differences, similar to those by which he has distinguished such a large number of species, are readily traced in the different stages of our Oceania. Professor Agassiz had separated the Hydroid figured by Wright, as a distinct genus, from Clytia, on account of the peculiar position of the marginal capsules, totally different from what is observed in that genus. The development of the Medusa shows this to be a correct appreciation of the differences noticed in the young; but as the genus of the adult Medusa is one already well known, Wrightia, the name given to the Hydrarium by Professor Agassiz, must be rejected. We have on our coast two species of Wrightiæ, one of which produces planulæ, and resembles, in its general appearance and mode of branching, the *Laomedea acuminata* figured by Wright in the Edinburgh New Philosophical Journal for 1856; the latter, however, produces Medusæ, while the second species is closely allied to the European *Campanularia syringa;* it has reproductive calycles similar to the calycles of the *Campanularia fastigiata* Alder; it differs considerably from the figure of the *C. syringa* given by Van Beneden, the stolon of our species being as strongly ringed as the pedicel; the calycle is likewise slightly constricted in the middle. This species has not been found with

Fig. 95. Magnified view of the actinostome. *T*, chymiferous tube; *f*, one of the four simple lobes of the actinostome.

reproductive calycles in March, April, or September; I am therefore unable to state whether it is the Hydrarium of our common Oceania.

A very young Oceania (Fig. 96), soon after its escape from the reproductive calycle, has a very deep bell (Fig. 96), two long tentacles and two rudimentary ones at the base of the chymiferous tubes. It resembles in its general appearance and motion the Medusa of *Clytia bicophora;* the bell is covered with large lasso cells, scattered irregularly over the surface; it can at once be distinguished from the latter

Fig. 96.

Fig. 97.

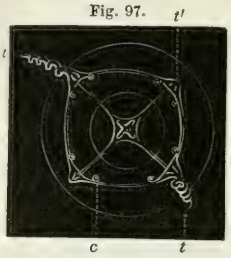
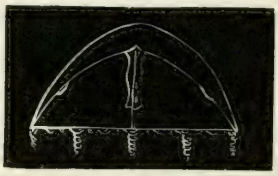


Fig. 98.



Medusa by the absence of ovaries, the two long tentacles (*t*, Fig. 97), and by what characterizes at once this genus, the position of the marginal capsules (*c*, Fig. 97) on each side of the primary tentacles (*t*, *t'*, Fig. 97), at the base of the chymiferous tubes, while in Clytia they are placed on each side of the secondary rudimentary tentacle, half-way between the chymiferous tubes. The young Medusa, in more advanced stages, has become quite conical (Fig. 98), the ovaries are forming, and, besides the two original long tentacles, we have the two rudimentary primary tentacles fully formed, as well as eight others half-way between the chymiferous tubes, and rudiments of eight additional tentacles half-way between these and the chymiferous tubes. The proboscis has likewise somewhat lengthened. In still older specimens, in which the fourth set of rudimentary tentacles has developed (t^4, Fig. 99), and in which we can trace the position of the remaining sixteen tentacles (t'', Fig. 99), the ovaries have also taken a greater development, and are now ellipti-

Fig. 99.

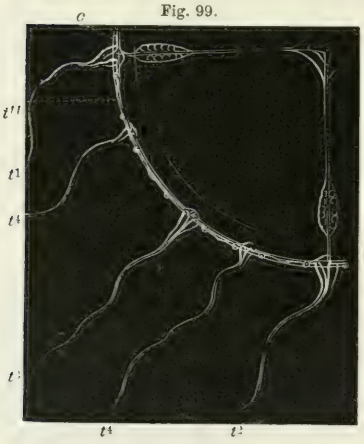


Fig. 96. Young Medusa of Oceania languida, immediately after escaping from the reproductive calycle.

Fig. 97. The same, seen from the actinal pole, to show the position of the marginal capsules, *c*, on the sides of the tentacles, *t*, *t'*.

Fig. 98. Somewhat more advanced Medusa, in which traces of the ovaries can be detected.

Fig. 99. Quarter of the disk of a still more advanced Oceania, where the remaining tentacles of the adult (t'') are developing between the tentacles, t^1, t^4, t^3, t^4, t^2, as well as additional marginal capsules, *c*.

cal pouches, occupying about one fifth of the length of the chymiferous tubes. With advancing age the bell of the Oceania grows more and more flattened, until, in the adult (Fig. 100), it has assumed the shape of a flat segment of a sphere. New marginal capsules are developed at the same time with the rudimentary tentacles, one between every two tentacles in the younger stages; afterwards there are from two to three capsules between the tentacles in the adult. The genital organs of the adult Medusa occupy more than two thirds the length of the chymiferous tubes; when distended with eggs, as in Fig. 101, they hang in irregular lobes from the point of attachment, *a*; the eggs are quite large; there is no difference in the shape of the male and female genital organs, those of the males are simply somewhat darker brownish-colored than the ovaries. These Medusæ are among the most common on our shores; they attain their full size during September, when they are frequently met in immense shoals on warm, still, sunny days, collected together for spawning. The young (Fig. 96) make their appearance as early as the end of May. The adult Medusæ assume the most extraordinary attitudes as they float along, carried about by the current; the disk is so extremely flexible that at times it seems almost as if the Medusa had rolled itself up, as in Figure 102, the tentacles being the strings by which the two edges have become fastened together. They are exceedingly lazy in all their movements, hardly contracting their tentacles when disturbed, contrasting strangely with their former activity in younger stages (Fig. 96), when they move through the water with short, rapid jerks, stopping only to take a more vigorous start. The young Medusæ of Campanularians are all very active, whatever may be the habits of the adults, while in the Tubularians we have generally in the young Medusæ the temperament of the adult. Young Medusæ of Bougainvillia, Lizzia, and Zanclea are lazy, like the adult;

Fig. 100.

a

Fig. 101.

Fig. 102.

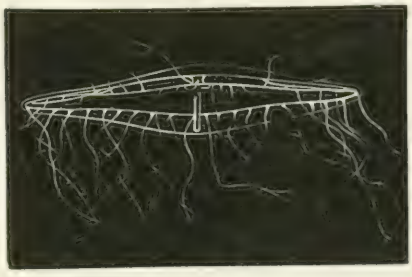


Fig. 100. Adult Oceania languida, natural size.
Fig. 101. Magnified view of an ovary. *a*, abactinal part of the genital organ.
Fig. 102. Peculiar attitude sometimes assumed by these Medusæ.

while Sarsia, Nemopsis, and Margelis are as active when young as when full grown.

Eastport, Maine (L. Agassiz); Massachusetts Bay (A. Agassiz); Buzzard's Bay (A. Agassiz).

Cat. No. 280, Naushon, A. Agassiz, September, 1861. Medusa.

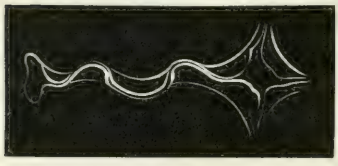
Cat. No. 450, Nahant, A. Agassiz, June, 1864. Medusa.

Oceania gregaria A. Agass.

Oceania gregaria A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 353. 1862.

This Medusa is somewhat smaller than its Eastern representative. It differs from it strikingly by the great length of the slender lips of the actinostome (Fig. 103); the color of the genital organs and of the sensitive bulb of the tentacles is a beautiful pale yellow, in strong contrast to the dark coloring of our species; the marginal tentacles are only moderately contractile. The whole surface of the water for several miles was often thickly covered with these Medusæ. Found in the Gulf of Georgia, from June to October.

Fig. 103.



Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 124, Gulf of Georgia, W. T., June, 1859, A. Agassiz. Medusa.

EUCHEILOTA McCr.

Eucheilota McCr. Gymn. Charl. Harb., p. 84.
Eucheilota Agass. Cont. Nat. Hist. U. S., IV. p. 353. 1862.

Eucheilota ventricularis McCr.

Eucheilota ventricularis McCr. Gymn. Charl. Harbor, p. 85, Pl. 11, Figs. 1–3; Pl. 1, Figs. 1, 2.
Eucheilota ventricularis Agass. Cont. Nat. Hist. U. S., IV. p. 353. 1862.
Eucheilota ventricularis A. Agass. Proc. Bost. Soc. Nat. Hist., IX. Figs. 16, 17.

Fig. 104.

The small Medusa represented in Fig. 104 is exceedingly common at Naushon, and I suppose it to be a young of this species, though I did not trace its development long enough to satisfy myself fully on this point. It has the characters of the genus as given by McCrady, with the exception of the ovaries, which were not yet developed in the oldest specimens observed. Young specimens, of a sixteenth of an inch in diameter, have four tentacles, one opposite each of the chymiferous tubes, of the length of the diameter of the

Fig. 103. One of the four lips of the actinostome of Oceania gregaria.
Fig. 104. Young of Eucheilota ventricularis McCr.

bell, with tentacular cirri well developed; two marginal capsules between each tentacle, and rudiments of four additional tentacles halfway between the capsules. (Fig. 105.) These tentacles have at first no lateral cirri; it is only when they have assumed the shape of the lower basal part of a full-grown tentacle that the cirri appear like two round knobs, which are rapidly developed into lateral cirri before the lash of the tentacle has been formed. The form of the young Medusa, with only four tentacles, is globular, but it soon becomes flattened as it advances in growth. The digestive cavity is a simple long tube, hanging stiffly in the interior of the bell, which has a very small circular opening; the chymiferous tubes are wide; the basal swelling of the tentacle is large and conical, narrowing very rapidly into the thread of the tentacle itself, which is exceedingly slender, with thin walls, and lasso cells scattered irregularly over its surface. The marginal capsules contain only one granule, while McCrady's species contains three or four. This may prove to be the specific difference between these young specimens and the Charleston species, as I have not, even in those specimens which had already eight tentacles, found more than one granule, except in a single case two, in one of the capsules.

Fig. 105

Charleston, S. C. (McCrady); Buzzard's Bay, Naushon (A. Agassiz).

Eucheilota duodecimalis A. Agass.

Eucheilota duodecimalis A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 353. 1862.

This species differs from the above in having twelve marginal capsules, one on each side of the four large tentacles (*c*, Fig. 107), and one in the middle of the circular tube (Fig. 106); there are four long tentacles, with lateral cirri (*t'*, Fig. 107) and long slender lashes, which are covered with lasso cells; the chymiferous tubes are wide, and from their point of junction with the circular tube arise ribbon-shaped genital organs (*o*, Fig. 107), which do not extend more than one third of the length of the chymiferous tube (Fig. 106); the disk is of very uniform thickness, the inner and outer surface of the bell being almost concentric to the very

Fig. 106.

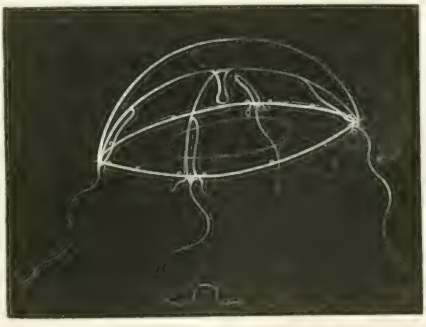


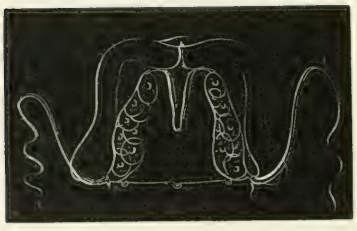
Fig. 105. More magnified view of a quarter of the disk, to show the position of the capsules and tentacular cirri. 2, the second set of tentacles in Figs. 104, 105.

Fig. 106. Eucheilota duodecimalis A. Agass.; greatly magnified.

Fig. 107.

edge ; in the cavity hangs a short urn-shaped digestive sac, attached to the four chymiferous tubes by a circular base, and not quadrangular, as in the *E. ventricularis ;* there is only a single granule in each of the marginal capsules. This species seems to be full grown, as the sexual glands were very much distended with spermaries, and I could not see any traces of additional tentacles ; however, as the presence of eggs and spermaries is far from being a criterion of maturity among these animals, we must have further materials to decide this point. Only three specimens of this species were found, — a very young female, the male here figured, and an older female (Fig. 107[a]), in which the ovaries were filled with apparently mature eggs, the genital pouches extending from the base of the chymiferous tubes to the base of the proboscis ; the thickness of the bell and its shape is totally different from that of the male, if it belongs to the same species ; the bell is of uniform thickness, quite squarish in outline ; the trace of the connection with the Hydrarium is still very distinct, and the tentacles are carried in the erect manner so characteristic of young Hydroid Medusæ, showing that, in spite of its well-developed ovaries, it must have but recently been liberated from its Hydrarium. The character of the difference between the young of these two species of Eucheilota makes it highly probable that the *E. duodecimalis* may form, when its adult is known, the basis for a separate genus ; we find in the arrangement of the capsules differences similar in character to those observed between the young of Oceania and of Clytia, the adult Medusæ of which are generically distinct, I cannot help surmising that we shall find differences of a like nature when the adult of *E. duodecimalis* becomes known. This is the more probable now that we know the young of *E. ventricularis*, the adult of which has so much the general appearance of an Oceania.

Fig. 107[a].



Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 453, Naushon, July, 1864, A. Agassiz. Medusa.

Fig. 107. Junction of one of the chymiferous tubes with the circular tube. *o*, spermary ; *c*, marginal capsule ; *t*, one of the four primary tentacles ; *t'*, tentacular cirri.

Fig. 107[a]. Female Medusa of Eucheilota duodecimalis ; greatly magnified.

CLYTIA LAMX.

Clytia LAMX. Bull. Soc. Phil.
Clytia AGASS. Cont. Nat. Hist. U. S., IV. pp. 297, 354. 1862.
Calicella HINCKS.
Trochopyxis AGASS. Cont. Nat. Hist. U. S., IV. pp. 297, 354. 1862.
? Platypyxis AGASS. Cont. Nat. Hist. U. S., IV. pp 306, 354. 1862.

The adult Medusa of *Platypyxis cylindrica* of Professor Agassiz is not known; he has separated this genus from Clytia from the character of the reproductive calycles only. The young Medusæ are very much alike, and we may have a case here, the reverse of what we find in Sarsia and Syndictyon, of Medusæ very similar in their younger stages, but totally different in the adult forms.

Clytia intermedia AGASS.

Clytia intermedia AGASS. Cont. Nat. Hist. U. S., IV. p. 305, Pl. 29, Figs. 10, 11. 1862.

Cat. No. 143, Nahant, Mass., April, 1855. H. J. Clark. Hydrarium.

Clytia volubilis A. AGASS.

Campanularia volubilis ALDER (*non* Auct). Cat. Zooph. Northumb. and Durham, p. 35.

Alder was the first to distinguish the several species which have been confounded under the name *C. volubilis* by different authors. Specimens in no way to be distinguished from the European *C. volubilis* have been found on our coast with their reproductive calycles, seeming to leave little doubt that the specimens here catalogued belong to this species.

Massachusetts Bay (L. Agassiz); Cape Cod (L. Agassiz).

Cat. No. 145, Norway, Sars. Hydromedusarium.

Cat. No. 146, Cape Cod, June, 1857, Captain N. E. Atwood. Hydromedusarium.

Cat. No. 432, Sea Coal Bay, N. S., 1861, Anticosti Expedition. Hydromedusarium.

Cat. No. 435, Mingan Islands, 1861, Anticosti Expedition. Hydromedusarium.

Clytia bicophora Agass.

Clytia bicophora Agass. Cont. Nat. Hist. U. S., IV. pp. 304, 354, Pl. 27, Figs. 8, 9 (as *C. cylindrica*); Pl. 29, Figs. 6–9. 1862.
Clytia bicophora A. Agass. Proc. Boston Soc. Nat. Hist., IX. Figs. 14, 15.
Clytia cylindrica Agass. (*p. p.*). Cont. Nat. Hist. U. S., IV. Fig. 14. 1862.

Under the name of *Eucope campanulata*, *Eucope Thaumantoides*, and *Eucope affinis*, Gegenbaur has described three species, which, to judge from the development of a similar Medusa of our coast, *Clytia bicophora*, are probably only different ages of the same species. The difference in shape of the ovaries in the different stages of the males and females, as seen in our Oceania, may account for the difference of form which Gegenbaur has found in the genital glands: I have been able to observe the same differences in our Clytia. The difference in the shape of the bell of his species is similar to what we find at different periods in our Clytia. When hatched from the calycle, the bell is globular (Fig. 108); the digestive cavity is a simple cylinder; the ovaries are hardly visible, as very short narrow lines on both sides of part of the upper half of the radiating tubes; there are only four tentacles. As it grows older, the actinal portion of the bell bulges out; the second set of tentacles, which were small bulbs, have now grown out, and there are traces of eight other tentacles (Fig. 109); the ovaries are also larger. At this stage the bell has the shape of a segment of a sphere, and has entirely lost its globular outline, the marginal capsules have not increased in number, there are only two between each radiating tube, just as we have them in the young Medusa at the time when they are freed from the reproductive calycle. In the next stage of the Medusa the rudimentary tentacles of Fig. 109 have developed into long flexible lashes, usually carried curled up, as in Fig. 110. In the adult of this Medusa there are no traces of any additional tentacles; though not measuring more than a quarter of an inch in diameter, yet they are very conspicuous on account of the accumulations of black pigment-cells in the bulb of the tentacles; two additional marginal capsules have also been formed, one on each side of the four primary tentacles; the ovaries are brownish purse-like

Fig. 108.

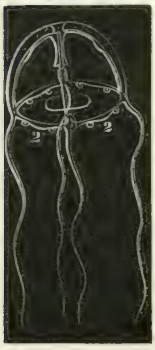


Fig. 109.

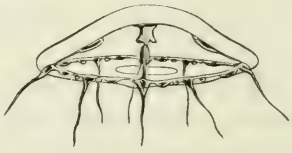


Fig. 110.

Fig. 108. Clytia bicophora, immediately after its escape from the reproductive calycle.
Fig. 109. A somewhat older Clytia bicophora.
Fig. 110. An adult Clytia bicophora, measuring one quarter of an inch.

glands, extending towards the base of the proboscis. The Hydrarium (see figure of Professor Agassiz in Vol. IV. Pl. 29, Fig. 6) grows from three quarters to an inch in height, in small tufts attached to Fucus; the calycles are strongly compressed (Fig. 111), and differ as much in their proportions as those of *C. cylindrica*, when seen from the broad or from the narrow side. This species may yet prove identical with the *Clytia Johnstoni* of Alder. According to the figure of Wright of the Medusa of *Campanularia Johnstoni*, it can hardly be distinguished from the Medusa of our *Clytia bicophora*; the Medusa of *C. volubilis* figured by Hincks resembles also closely our Clytia Medusæ. The Medusa figured by Dalyell as the young of *M. fimbriata*, on Pl. 52, Fig. 4, Rare and Remarkable Animals of Scotland, is undoubtedly a young Medusa of *C. Johnstoni*, to judge from its characteristic attitude. If the figure which Gosse has given of the calycle of this same species in his "Devonshire" is correct, there can be but little question as to their specific difference; the peculiar species figured by Gosse has, however, not been noticed by other English observers. The Medusæ of *Clytia cylindrica* and of *Clytia bicophora* are so alike, immediately after their escape from the reproductive calycles, that when the development of *Clytia cylindrica* was first discovered, the Medusæ which are here figured as *Clytia bicophora* (Fig. 41, Agassiz's Cont. Nat. Hist., p. 307) were mistaken for the adult of the Medusæ of *Clytia cylindrica*. As the *Clytia bicophora* is very common at Nahant, the complete development of the Medusa has been traced, and the error is here corrected.

Fig. 111.

Eastport, Maine (W. Stimpson); Massachusetts Bay (Agassiz); Vineyard Sound and Naushon (L. and A. Agassiz).

Cat. No. 133, Eastport, Maine, July, 1852, W. Stimpson. Hydromedusarium.

Cat. No. 134, Beverly, Mass., July, 1861, A. Agassiz. Hydrarium.

Cat. No. 135, Vineyard Sound, July, 1849, L. Agassiz. Hydromedusarium.

Cat. No. 136, Grand Manan, August, 1857, J. E. Mills. Hydromedusarium.

Cat. No. 137, Nahant, Dec. 1855, H. J. Clark. Hydromedusarium.

Cat. No. 154, Eastport, Maine, July, 1852, W. Stimpson.

Cat. No. 401, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

Cat. No. 443, Nahant, June, 1864, A. Agassiz. Medusa.

Museum diagram No. 17, after L. and A. Agassiz.

Fig. 111. Sterile Hydra and reproductive calycle, seen from the broad side.

PLATYPYXIS Agass.

Platypyxis Agass. Cont. Nat. Hist. U. S., IV. pp. 306, 354. 1862.

Platypyxis cylindrica Agass.

Clytia (*Platypyxis*) *cylindrica* Agass. Cont. Nat. Hist. U. S., IV. pp. 306, 354 (*non* Pl. 27, Figs. 8, 9); p. 307, Figs. 42–44 (*non* Fig. 41). 1862.
Campanularia volubilis Leidy. Mar. Inv. Faun. N. Y. and R. I., p. 6. 1855.
Campanularia noliformis McCr. Gymn. Charl. Harb., p. 92, Pl. 11, Fig. 4. ?

The reproductive calycle is conical, smooth, strongly compressed in one direction, with a slight constriction near the free end, which flares outwards (Fig. 112); there are from three to four young Medusæ developing simultaneously, though only one seems to escape at a time, and not several in close succession, as is the case with Laomedea; the Medusa nearest the upper extremity occupies more than half of the whole space; there is nothing here like the corrugations which

Fig. 112.

Fig. 114.

Fig. 113.

Gosse has figured in his *C. volubilis*, or of the spur which projects beyond the point of attachment of the calycle; when seen edgeways, the calycle is strongly bent at the base (Fig. 113), and the upper edges do not flare out, as when seen from the broad side. The Hydrarium (Fig. 114) is found in shady places, near low-water-mark, and immediately beyond it; largest specimens about an eighth of an inch in height.

Charleston, S. C. (McCrady); Point Judith (Leidy); Massachusetts Bay, Nahant (L. Agassiz); Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 141, Naushon, Sept. 1861, A. Agassiz. Hydromedusarium.

Cat. No. 142, Nahant, Mass., Sept. 1854, H. J. Clark. Hydrarium.

Fig. 112. Reproductive calycle of P. cylindrica, seen from the broad side.
Fig. 113. The same, seen from the narrow side.
Fig. 114. Sterile Hydra of P. cylindrica.

ORTHOPYXIS Agass.

Orthopyxis Agass. Cont. Nat. Hist. U. S., IV. pp. 297, 355. 1862.
Clytia Lamx (*p. p.*). Bull. Soc. Phil. 1812.
? Silicularia Meyen. Nov. Act., XVI. 1834.

Orthopyxis poterium Agass.

Orthopyxis poterium Agass. Cont. Nat. Hist. U. S., IV. pp. 297, 302, Fig. 40; p. 355; Pls. 28, 29, Figs. 1–5. 1862.

Massachusetts Bay (Agassiz); Nova Scotia (Anticosti Expedition).
Cat. No. 125, Nahant, April, 1856, H. J. Clark. Hydromedusarium.
Cat. No. 126, Nahant, June, 1861, A. Agassiz. Hydrarium.
Cat. No. 127, Nahant, July, 1861, A. Agassiz. Hydrarium.
Cat. No. 128, Nahant, August, 1861, A. Agassiz. Hydrarium.
Cat. No. 129, Nahant, September, 1854, H. J. Clark. Hydrarium.
Cat. No. 130, Nahant, December, 1854, H. J. Clark. Hydrarium.
Cat. No. 131, Nahant, March, 1856, H. J. Clark. Hydrarium.
Cat. No. 400, Nahant, Mass., 1862, A. Agassiz.
Cat. No. 414, Mingan Islands, N. S., Anticosti Expedition, 1861.
Museum Diagram No. 18, after L. Agassiz.

Family EUCOPIDÆ Gegenb.

Eucopidæ Geg. (*emend* Agass.). Zeit. f. Wiss. Zool., p. 241. 1856.
Eucopidæ Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1862.

Great confusion has always existed in the identifications made of the different species of Campanularians, on account of the difficulty of distinguishing in certain stages closely allied species. If, however, we are fortunate enough to examine them at the breeding season, when the characteristic reproductive calycles of the different species are in their full development, our task will be greatly facilitated; and any doubts we may still have of the identity or difference of closely allied species will be entirely removed, should we succeed in tracing the development of the young Medusa. Although we may find it impossible to distinguish, at certain stages of growth, young Medusæ, it by no means follows that these Medusæ, which have developed from Campanularians easily distinguished, are identical. (Compare the different Campanularians figured in the sequel.) Whenever we succeed in tracing the complete history of any one of our Jelly-fishes, we always find that we are able to distinguish readily closely allied species, which our previous ignorance had led us to consider as

identica.; as, for example, the Medusæ of *Eucope polygena*, *Eucope diaphana*, *Eucope pyriformis*, and *Eucope articulata*. The strongest case we can cite is perhaps that of Syndictyon and Coryne, the adult Medusæ of which had long been distinguished by the difference of color of the sensitive bulb; but whether this was anything more than mere individual differences could not be ascertained till we became acquainted with the complete development of the former genus, which will be found given in its place in this Catalogue. Hincks, after some observations limited to two genera of Hydroids, came to the conclusion that we could have Medusæ, generically identical, developed from Hydroids generically distinct; this is so entirely opposed to anything known in the history of the development of these animals, and so totally disproved by the examples of Campanularians here described, that I believe that, when the complete history of the two Medusæ described by Hincks is fully known, we shall find we have only a case of very close affinity at one stage of their development, and that, as we become acquainted with their more advanced stages, differences will be perceptible.

The different species of Eucopidæ found on our coast, of which we know the development, explain many of the contradictory statements of European writers concerning the mode of development of the different species of Eucope. It has been shown only more recently that many of the species, so closely allied as to be readily mistaken at any time, except the breeding season, were reproduced, on the one hand by Planulæ, and on the other by Medusæ; and now it is found that the Medusæ produced from Hydroids which have been considered identical species, develop into very different adult forms. See, for example, the differences in the Medusæ of *Laomedea geniculata*, figured by Wright and Gosse; one has ovaries and the other has none, immediately after its escape from the reproductive calycle, as in our *Eucope diaphana* and *Eucope articulata*. The *Laomedea gelatinosa* of Van Beneden has twenty-four tentacles and ovaries, as in our *Eucope pyriformis*, to which it is closely allied, while the Medusa of *Laomedea gelatinosa* of English writers has sixteen tentacles at first, and is an Obelia. The European Campanularians require a thorough revision in order to extricate them from the confusion existing in their synonymy, and this can only be done after a thorough acquaintance with the development of their Medusæ.

The *Laomedea dichotoma* of Dalyell is probably the same as the *Campanularia gelatinosa* of Van Beneden. The same confusion occurs in the fourth volume of Professor Agassiz's Contributions; the Eucope which is there figured as *Eucope diaphana* Agass., and the Campanularian of that name (Plate 34), is not the Hydroid of *Eucope diaphana*, as will be seen in the description of the latter. The

Eucope diaphana of the fourth volume (not that of the Memoirs of the American Academy) is probably identical with the English *Eucope geniculata* of Wright, not that of Gosse, and it may hereafter be designated as *Eucope alternata*.

EUCOPE Gegenb.

Eucope Gegenb. Versuch eines System; Zeit. f. Wiss. Zool., p. 241. 1856.
Eucope Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1864.

Eucope diaphana Agass.

Eucope diaphana Agass. (*ex p.*). Cont. Nat. Hist. U. S., IV. Pl. 33, Fig. 2. Hydrarium. 1862.
Thaumantias diaphana Agass. Mem. Am. Acad., IV. p. 300, Figs. 1, 2.
Eucope diaphana A. Agass. Proc. Bost. Soc. Nat. Hist., IX. p. 92, Figs. 7–9.
Thaumantias diaphana Mörch; in Beskriv. af Grönland, p. 96. 1857.

This is by far the most common of our Jelly-fishes; it does not grow to a large size, adult specimens not measuring more than a quarter of an inch across the disk. On escaping from the reproductive calycle, the little medusa has but twenty-four tentacles, and is constantly swimming with the disk turned inside out, as in Fig. 115; at the base of two of the tentacles (t', t', Fig. 116), situated on both sides of the middle tentacle, between the chymiferous tubes, are found large spherical capsules; there are no traces of ovaries to be found in this early stage, it is not till the second set of tentacles begin to develop (2, Fig. 117) that they make their appearance. Young tentacles do not possess the root-like projection at their base; this is only developed in older tentacles of more advanced Medusæ. (See Fig. 120.) With advancing age the Medusæ lose the habit of swimming with the proboscis uppermost, and gradually assume the usual mode of swimming of Jelly-fishes. The young Eucope of Fig. 117 develops rapidly additional tentacles, the ovaries increase in size, and we soon have an adult Medusa, with large bag-like ovaries, a

Fig. 115.

Fig. 116.

Fig. 117.

Fig. 115. A Eucope diaphana just after its escape from the reproductive calycle, seen in profile.

Fig. 116. One quarter of the disk of the same, seen from above. t, tentacle opposite chymiferous tube; t', t', tentacles with capsules.

Fig. 117. A more advanced Eucope, in which the second set of tentacles (2) is developing between the original tentacles (1).

short proboscis, and an extremely attenuated disk, as in Fig. 118. Fig. 119, which is a still more magnified view of a quarter of the disk, seen from above, shows the extraordinary increase of the number of tentacles, and the position of the genital organs near the circular tube. As the Medusæ become older, a sort of sensitive bulb is formed at the base of the tentacles, in which a little pigment matter is accumulated (*b*, Fig. 120); this bulb is hardly perceptible in younger

Fig 118

Fig. 119

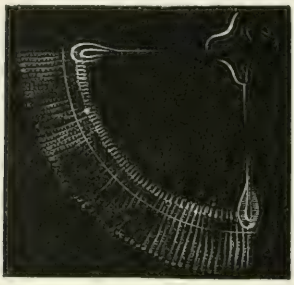
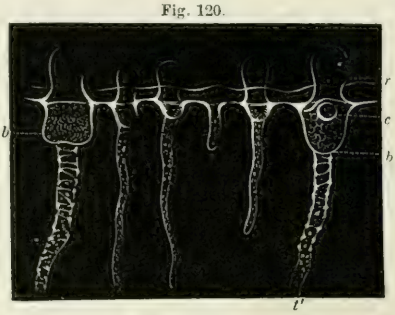


Fig. 120.



tentacles, and is totally wanting in the young Medusæ. The original number of the capsules between every two chymiferous tubes is not changed as the tentacles become more numerous; in adult specimens (Fig. 119) there are only two to be found, as in the youngest Medusæ, just escaped from the calycle. When examining a part of the circular tube of a Eucope somewhat more advanced than the stage represented in Fig. 117, we find only a great increase in the sensitive bulbs and the root of the tentacles (*r*, Fig. 120), but we can perceive nowhere, in any of the most advanced tentacles, the least trace of additional capsules, such as are found in the two tentacles, *t'*, *t'*, Fig. 116, and *t'*, Fig. 120. The capsules (*c*, Fig. 120) have the same shape and position they had in younger Medusæ. The genital organs, at first mere swellings of the chymiferous tubes (Fig. 117), soon develop into regular pouches, which hang down on both sides of the tube; the tube also forms a sort of pocket at the point of attachment of the pouch. (*a'*, *a''*, *a'''*, Fig. 121.) This pocket is readily seen in the male (Fig. 121); its shape, when seen from above, changes considerably according to the position of the genital pouch. (*a'*, *a'''*, Fig. 121.) The shape of the spermaries has

Fig. 121.

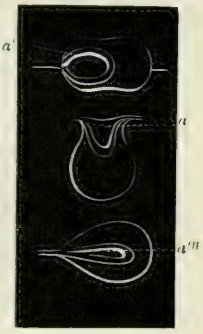


Fig. 122.

Fig. 118. An adult Eucope diaphana, seen in profile.

Fig. 119. A quarter of Fig. 118, more magnified.

Fig. 120. Magnified view of the circular tube of a young Eucope. *b*, sensitive bulb; *r*, root of tentacle; *c*, capsule; *t'*, tentacle with capsule.

Fig. 121. Spermaries; *a'*, seen from above; *a''*, in profile; *a'''*, different attitude from above.

Fig. 122. Female genital organs.

a tendency to be somewhat rectangular or bottle-shaped (Fig. 121), while the ovaries, when distended with eggs (Fig. 122), are more generally spherical; the number of eggs in an adult female are not numerous, not more than twelve to fifteen; the eggs are quite large, and have a very sharply defined germinative vesicle. The proboscis (Fig. 123) lengthens but little in older Medusæ, almost the only change being the greater mobility of the lips of the actinostome; the veil is totally wanting in young Medusæ, and in the adult is a very narrow ribbon round the circular tube, hardly extending beyond the root of the tentacles, so that it easily escapes notice.

Fig. 123.

This Medusa is exceedingly phosphorescent, having a very white brilliant light, which is given out most strongly at the base of the long tentacles. These Medusæ appear as early as March, and are found as late as November. The Hydrarium (Fig. 124) grows to but little more than an inch in height, and resembles *Laomedea geniculata;* but the absence of the knee at the base of the sterile Hydra, and the long ringed branch supporting it, distinguish it at once from that species. The calycle is elliptical, arching regularly towards the centre, and tapering at the two ends (Fig. 125); from twelve to fifteen Medusæ develop in each calycle. Found at near low-water-mark, attached to the base of *Fucus vesiculosus.*

Fig. 124.

Fig. 125.

It may be that the Medusa of *Laomedea geniculata* of Gosse, figured on Plate IV. of his "Devonshire," may prove to be the young of *Thaumantias lucida* of Forbes, which is the English representative of our *Eucope diaphana.* Should this be the case, the two species are evidently distinct, and representative species in the Acadian and Lusitanian Fauna. Is not the *Medusa fimbriata* of Dalyell (Pl. 52, Figs. 6, 7) the same as the Medusa of *Laomedea geniculata,* and is it not also identical with the *Thaumantias lucida* of Forbes?

Massachusetts Bay, Nahant (Agassiz); Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 78, Nahant, July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 79, Naushon, Sept. 1861, A. Agassiz. Hydromedusarium.
Cat. No. 281, Naushon, Sept. 1861, A. Agassiz. Hydromedusarium.

Fig. 123. Proboscis of an adult Medusa.
Fig. 124. Hydrarium of Eucope diaphana, natural size.
Fig. 125. Magnified view of sterile Hydra and of a reproductive calycle.

Eucope alternata A. Agass.

Eucope diaphana Agass. (*ex. p.*). Cont. Nat. Hist. U. S., IV. pp. 322, 352, Pl. 34, Figs. 1–9. 1862. Non *Th. diaphana* Agass., Mem. Am. Ac.

This species was at first mistaken by Professor Agassiz for the young of *Thaumantias diaphana*, figured in the Memoirs of the American Academy. The development of the Hydrarium of these two closely allied forms shows that two species have been confounded.

Massachusetts Bay, Nahant (Agassiz).

Cat. No. 83, Nahant, Mass., Aug. 1861, A. Agassiz. Hydromedusarium.
Cat. No. 84, Nahant, September, 1854, H. J. Clark. Hydrarium.
Cat. No. 85, Nahant, May, 1862, A. Agassiz. Hydrarium.
Cat. No. 86, Nahant, July, 1861, A. Agassiz. Hydrarium.
Cat. No. 87, Nantasket, April, 1861, H. B. Rice. Hydrarium.
Cat. No. 88, Nahant, L. Agassiz.
Cat. No. 394, Nahant, July, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 395, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

Eucope polygena A. Agass.

The only adult Medusa of the genus Eucope, of which we know the complete development, being *Eucope diaphana*, it is not possible at present to decide whether we have not among these closely allied Campanularians the Hydraria of several genera. There are certainly differences among the young Medusæ, at the moment of escaping from the calycles, which must give them totally distinct characters when adult, to judge by what we know of the mode of development of marginal tentacles, and the increase in size of the genital organs. There is a great similarity in the young Medusæ of *Eucope articulata*, *E. pyriformis*, *E. alternata*, and *E. polygena*, all these species having twenty-four hollow tentacles, and ovaries close to the base of the proboscis, at the time they escape from the reproductive calycles; while in *E. diaphana* and *E. geniculata* Gosse we have twenty-four tentacles, nearly solid, and no ovaries in the younger stages. Another type occurs in *Obelia commissuralis* and *Laomedea gelatinosa* of English authors, where the Medusa has sixteen tentacles and no ovaries; and finally there is a still different type in the *Eucope fusiformis* and *Laomedea divaricata* of McCrady, in which we find forty-eight tentacles at the time of hatching, and long spindle-shaped genital organs along the chymiferous tubes. These are undoubtedly good structural characters upon which genera can easily be distinguished, but it would be premature to make all these divisions until we know,

from actual observations, in what manner these differences of the young Medusæ are carried out in the adult. The Hydrarium and the Medusa of several species are described here under the generic name of Eucope, simply to call attention to the great structural differences found among Campanularians apparently so closely related.

Eucope polygena is remarkable for the short stems of the sterile Hydra, the stoutness of the main stem, and the great number of Medusæ developed in a single reproductive calycle; the bell is flaring, with a smooth edge, and rather shallow; the reproductive calycles are elliptical, slightly wavy (Fig. 126), and somewhat bottle-shaped at the extremity. The Medusa resembles closely that figured by Professor Agassiz as *Eucope diaphana*, in Vol. IV. Pl. 34, Fig. 9, Contributions to the Natural History of the United States; the tentacles are larger in proportion to the size of the disk. This species is found growing on stems of Laminaria, in small branching tufts, of one to two inches in height.

Fig. 126.

Cat. No. 393, Nahant, June, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 399, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

Eucope parasitica A. Agass.

This species is closely allied to the *E. polygena;* it has, like it, short branches, composed of not more than three or four rings, supporting the sterile Hydræ; the inner walls of the stems are parallel to the outer wall; the sterile Hydræ go off nearly at right angles to the stem; the reproductive calycles are very graceful, terminating with a peculiar mitre-shaped top. The Medusa has twenty-four tentacles; it has thus far only been found growing on a species of Penella, parasitic on *Orthagoriscus mola.*

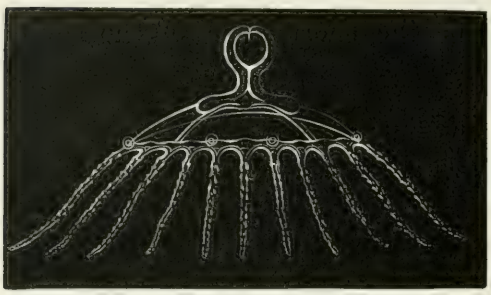
Massachusetts Bay, Nahant (A. Agassiz).
Cat. No. 80, Nahant, August, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 81, Nahant, August, 1856, L. Agassiz. Hydromedusarium.

Fig. 126. Magnified view of part of main stem of E. polygena.

Eucope pyriformis A. Agass.

Laomedea gelatinosa Leidy (*non* Auct.). Mar. Inv. New York and Rhode Island, p. 6. 1855.

Fig. 127.



This Medusa has, on its escape from the reproductive calycles, small pear-shaped ovaries placed close to the digestive cavity (Fig. 127), which is short and almost globular; there are four chymiferous tubes; the tentacles are shorter than in *Obelia commissuralis*, and not as slender; at the moment of hatching there are twenty-four tentacles, five between each of the chymiferous tubes (Fig. 128), and two large marginal capsules, with one granule in each, placed a little on one side (towards the circular tube) of the two tentacles adjoining the middle one between the chymiferous tubes; the lasso cells are arranged in broken rings round the tentacles. The Hydrarium (Fig. 129) is found growing in large quantities on the eel-grass; the walls of the tube run parallel to the outer envelope; there are no knees or breaks in the continuity, nor are there any swellings where the reproductive calycles are attached; the branches are wide apart, the whole tuft spreading like a bush; the bell of the hydra is short and flaring, and is attached to the main stem by a long branch, having from twelve to fifteen rings. The reproductive calycles vary greatly in shape during their growth; when small, they are almost rectangular, with rounded corners, and a slight constriction in the middle; as they become larger, they grow more pear-shaped; and in still more advanced stages the calycles assume the shape of an elongated ellipse, with a pointed cap, and three or four deep constric-

Fig. 128.

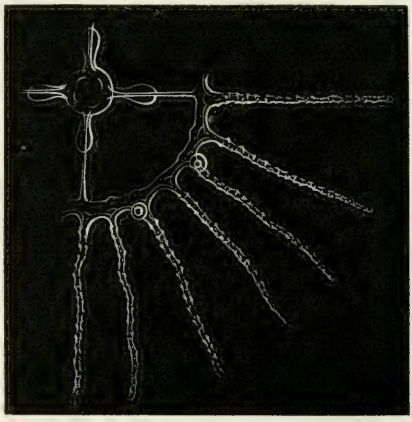


Fig. 129.

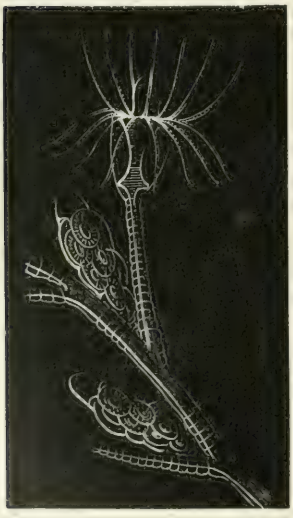


Fig. 127. E. pyriformis, seen in profile; greatly magnified.
Fig. 128. Quarter of disk of same Medusa.
Fig. 129. Portion of Hydrarium of E. pyriformis; magnified.

tions. There are from nine to twelve Medusæ growing in each calycle at once.

This species is closely allied to the *Campanularia gelatinosa* of Van Beneden, and to the *Campanularia dichotoma* of Dalyell. The details of structure of the Hydrarium, especially the reproductive calycles and the stem of the sterile Hydra, seem to prove that they are different species. The mode of branching is the same in both. Compare Van Beneden, Pl. 1, Fig. 1, Campanulaires de la Côte d'Ostende, and the figures of the Medusæ here given.

Point Judith (Leidy); Beverly, Massachusetts Bay (Alex. Agassiz); Grand Manan (Mills).

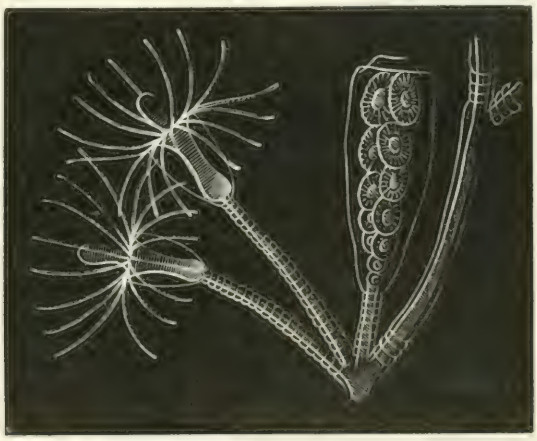
Cat. No. 74, Beverly, Mass., July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 75, Nahant, Mass., July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 76, Grand Manan, Aug. 1857, J. E. Mills. Hydrarium.
Cat. No. 77, Grand Manan, Aug. 1857, J. E. Mills. Hydrarium.

Eucope articulata A. Agass.

This species is so closely allied to *Eucope pyriformis* that the Medusæ can hardly be distinguished. The Medusa of *Eucope articulata* (Fig. 130) has more slender marginal tentacles, and the lips of the actinostome are deeply cleft and extremely movable, which is quite the contrary of what we find in young Medusæ of Eucopidæ. The

Fig. 130

Fig. 131.



Hydrarium is at once recognized by the extraordinary length of the ringed branch supporting the sterile Hydræ, the cups of which are quite deep and narrow. The reproductive calycle (Fig. 131) resembles in shape that of *Obelia commissuralis*, but is in addition supported upon

Fig. 130. Quarter of the disk of Eucope articulata; magnified.
Fig. 131. Portion of a Hydrarium of Eucope articulata.

a larger pedicel, having from eight to ten rings. It is very common to see the sterile Hydræ, placed as in the figure (Fig. 131), in pairs at the base of the reproductive calycle. The Hydrarium grows to about the size of the *Eucope pyriformis*, from three to four and even five inches high, and is readily mistaken for the Hydrarium of *Obelia commissuralis*. It grows in pools on rocks at low-water-mark.

Cat. No. 396, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

Cat. No. 397, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

Eucope? fusiformis A. Agass.

Eucope? A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 91, Fig. 6.

From a Hydrarium, in which the cavity of the main stem passes from one side to the other (*s*, *s*, Fig. 132), similar in its mode of branching to that of *Eucope diaphana*, but in which the Hydræ, remarkable for their small bell, *b*, are attached to the main stem by short branches, not having more than three or four rings (Fig. 132), is produced a small Medusa of a sixteenth of an inch in diameter, having, when hatched, four long fusiform ovaries (Fig. 133), occupying nearly the whole length of the chymiferous tubes, and forty-eight long, slender tentacles, having well-developed rootlets, usually carried quite stiffly, with two marginal capsules between each pair of chymiferous tubes, occupying the same position as in *E. diaphana*, when it has forty-eight tentacles. The digestive cavity is quite long and movable, and differs from that of the last species by the more marked lobes of the actinostome. The different species of Eucopidæ, thus far described, can easily be distinguished by the number of tentacles, the presence or absence of the ovaries, and their position when they escape from the reproductive calycles. Among the many specimens of *E. diaphana* which I had occasion to examine, I have only found two in which there were not twenty-four tentacles on hatching, and in the *Obelia commissuralis* and *E. pyriformis* the same holds good; the number of tentacles at the time of escape from the calycles being very constant.

Fig. 132.

Fig. 133.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 90, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Fig. 132. Hydrarium of Eucope fusiformis; magnified.

Fig. 133. Quarter of the disk of the Medusa of Eucope fusiformis; greatly magnified.

Eucope? divaricata A. Agass.

Laomedea divaricata McCr. Gymn. Charl. Harb., p. 93.

An examination, by Professor Clark, of the reproductive calycles of specimens collected at Charleston by Professor Agassiz, shows that the Medusæ have forty-eight tentacles. The Hydrarium is closely related to that of the *Eucope pyriformis*, which, together with the present species, will probably form the basis for a new genus.

Charleston, S. C. (L. Agassiz).

Cat. No. 82, Charleston, S. C., January, 1852, L. Agassiz.

OBELIA Pér. et Les.

Obelia Pér. et Les.; in Ann. du Mus., XIV. p. 43. 1809.
Obelia Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1862.
Obelia McCr. Gymn. Charl. Harb., p. 94.

Obelia commissuralis McCr.

Obelia commissuralis McCr. Gymn. Charl. Harb., p. 95, Pl. 11, Figs. 5–7.
Obelia commissuralis Agass. Cont. Nat. Hist. U. S., IV. pp. 315, 351, Pls. 33 (*non* Fig. 2), 34, Figs. 10–21. 1862.
Obelia commissuralis A. Agass. Proc. Bost. Soc. Nat. Hist., IX. p. 91, Fig. 5.
Laomedea dichotoma Leidy (*non* Auct.). Mar. Inv. N. J. and R. I., p. 6, Pl. XI. Fig. 36. 1855.
Laomedea gelatinosa Stimps. (*non* Auct.). Mar. Inv. Grand Manan, p. 8. 1853.
Laomedea gelatinosa Gould. Rep. Inv. Mass. Bay, p. 350. 1841.

The *Obelia commissuralis* of McCrady, which extends from Charleston to the coast of New England, and even as far as Grand Manan, has an exceedingly slender polypidon and branches very profusely; the branches, stretching in graceful curves on both sides of the main stem, reach their greatest length about midway, and then taper very gradually towards the upper extremity. It can at once be distinguished on account of its peculiar mode of growth; it attains from five to six and even seven inches in length. At the time when it bears reproductive calycles, it is still more easily distinguished from the allied species by the shape of the calycles; they are slender, conical, the base of the cone with its rounded edges being surmounted by a short neck (Fig. 134); they bear from ten to

Fig. 134.

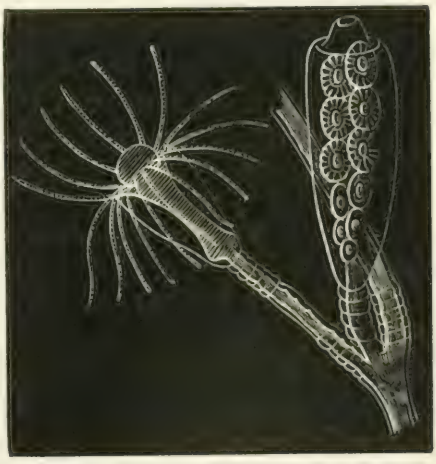


Fig. 134. Portion of stem of Hydrarium of Obelia commissuralis.

twelve and even sixteen Medusæ. The young Medusa (Fig. 135), when hatched, has sixteen tentacles, four chymiferous tubes, a rather long cylindrical digestive cavity, with four labial lobes; there are no ovaries yet developed. I have not found these Medusæ in a more advanced condition, though they become free in the first weeks of July, and are found during the whole summer, as late as September, but in no case were there any ovaries developed. In confinement they do not prosper, and after a few days die, without assuming a different shape from that in which they become free. The tentacles are slender, as long as the diameter of the disk; in two of the tentacles there are large marginal capsules in a swelling on the under side; the re-entering spur of the tentacles is small. There is considerable difference between the Hydrarium of the specimens found at Charleston and those of our coast; the Charleston specimens are uniformly thinner and more slender; it remains yet to be seen whether any further specific differences can be detected in the Medusæ. If Van Beneden's figure of the *Campanularia geniculata* is correct, the European and the American species of Obelia are distinct.

Fig. 135.

Absecom Beach (Leidy); Charleston (McCrady); Buzzard's Bay, Naushon (A. Agassiz); Massachusetts Bay and Grand Manan (Agassiz).

Cat. No. 65, Charleston, S. C., January, 1852, L. Agassiz. Hydromedusarium.

Cat. No. 66, Charleston, S. C., February, 1852, L. Agassiz. Hydromedusarium.

Cat. No. 67, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 68, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 69, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 70, Nahant, Sept. 1861, A. Agassiz. Hydromedusarium.

Cat. No. 71, Grand Manan, Sept. 1857, J. E. Mills. Hydromedusarium.

Cat. No. 72, Nahant, July, 1857, L. Agassiz.

Cat. No. 73, Newport, R. I., Dr. Leidy.

Cat. No. 392, Nahant, July, 1862, A. Agassiz.

Fig. 135. Quarter-disk of the Medusa of Obelia commissuralis.

LAOMEDEA Lamx.

Laomedea Lamx.; in Bull. Soc. Phil. 1812.
Laomedea Agass. Cont. Nat. Hist. U. S., IV. p. 352. 1862.
Campanularia Lamk. (*p. p.*). An. s. Vert., II. p. 129.

Laomedea rigida A. Agass.

This species is remarkable for its peculiar mode of growth. At first glance it would readily be mistaken for a species of Dynamena, so regular is the succession of the hydræ along the stem, and also on account of the absence of branches. The sterile and reproductive hydræ are found on the sides of the main stem, attached by a very short pedicel, and alternate so regularly on each side that its Campanularian nature is noticed only after a careful examination. The sterile hydræ resemble those of *Laomedea amphora*, while the reproductive calycles are identical in shape with those of *Obelia commissuralis*. The main stems of a cluster are closely crowded together, and attain a height of three to four inches.

Cat. No. 122, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.

Laomedea amphora Agass.

Laomedea amphora Agass. Cont. Nat. Hist. U. S., IV. pp. 311, 314, Fig. 50; p. 352, Pls. 30, 31, Figs. 1–8. 1862.

Massachusetts Bay (Agassiz); Grand Manan (Mills); Long Island Sound (Leidy, A. Agassiz).

Cat. No. 91, Nahant, July, 1852, H. J. Clark. Hydromedusarium.
Cat. No. 92, Nahant, July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 93, Nahant, July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 94, Nahant, March, 1861, H. J. Clark. Hydromedusarium.
Cat. No. 95, Nahant, April, 1855, H. J. Clark. Hydrarium.
Cat. No. 96, Nahant, 1857, L. Agassiz. Hydrarium.
Cat. No. 97, Nahant, March, 1856, H. J. Clark. Hydromedusarium.
Cat. No. 98, Naushon, Sept. 1861, A. Agassiz. Hydromedusarium.
Cat. No. 99, Grand Manan, Aug. 1857, J. E. Mills. Hydromedusarium.
Cat. No. 100, Newport, R. I., S. Powell. Hydromedusarium.
Cat. No. 101, Newport, R. I., Dr. J. Leidy. Hydromedusarium.
Cat. No. 102, Boston, March, 1856, H. J. Clark.
Cat. No. 114, Nahant, Sept. 1854, H. J. Clark. Young?
Cat. No. 398, Nahant, July, 1862, A. Agassiz.
Museum Diagram No. 18, after L. Agassiz.

Laomedea gigantea A. Agass.

This species of Laomedea, found growing in the brackish water of Charles River, grows to an enormous size, as much as fifteen to twenty inches. It sends off only short branches from the stout principal stem, so that in its general appearance it resembles somewhat *Sertularia cupressina;* the branches, however, are very closely arranged round the main stem; near the extremity we often find, in very large specimens, the branches spreading out somewhat fan-shaped. It can readily be distinguished from its congener, the *L. amphora*, by the shape of the calycles, which are totally different; they are elliptical, flaring but slightly towards the opening, and taper off somewhat suddenly, with a bottle-shaped extremity entirely unlike the calycles of *L. amphora.*

Boston Harbor (H. J. Clark).

Cat. No. 103, Boston, July, 1861, H. J. Clark. Hydromedusarium.

Cat. No. 104, Boston, July, 1861, H. J. Clark. Hydromedusarium.

Cat. No. 105, Boston, July, 1861, H. J. Clark. Hydromedusarium.

Laomedea pacifica A. Agass.

This is another gigantic species closely allied to *Laomedea amphora;* the reproductive calycles are similar in both; the main stem of this species is exceedingly stout; the mode of branching resembles that of *L. gelatinosa.* Specimens of this species have been collected by Dr. Stimpson, of the North Pacific Exploring Expedition under Commodore Rodgers, in Behring's Straits, and in Avatska Bay, Kamtschatka.

Gulf of Georgia, W. T. (A. Agassiz); San Francisco, Cal. (A. Agassiz).

Cat. No. 117, Gulf of Georgia, W. T., June, 1859, A. Agassiz.

Cat. No. 118, San Francisco, Cal., December, 1859, A. Agassiz.

Cat. No. 120, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.

Family ÆQUORIDÆ Esch. (*rest.* Ag.)

Æquoridæ Esch. (*emend.* Agass.). Syst. d. Acal., p. 108. 1829.
Æquoridæ Agass. Cont. Nat. Hist. U. S., IV. p. 359. 1862.

RHEGMATODES A. Agass.

Rhegmatodes A. Agass.; in Agass. Cont. Nat. Hist. U. S., IV. p. 361. 1862.

Umbrella flat, chymiferous tubes numerous, digestive cavity short, with small lips scarcely fimbriated; the chymiferous tubes extend along the prolongation of the umbrella into the cavity of the bell; large tentacles, somewhat more numerous than the chymiferous tubes, very contractile. To this genus I suppose that Gosse's *Æquorea forbesiana* belongs; it is closely allied to Stomobrachium Brandt (*non* Forbes), and differs from it in not having numerous long marginal tentacles, in the greater number of radiating tubes, and the numerous short lips at the extremity of the digestive cavity. Like Æquorea and Zygodactyla, it has marginal capsules, and the peculiar spur at the base of the large tentacles. Two species of this genus have been noticed on our coast; the one in Florida, by Professor Agassiz, and the other at Naushon.

Rhegmatodes tenuis A. Agass.

Rhegmatodes tenuis A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 361. 1862.

This is a large species; specimens measuring between three and four inches have frequently been found. The spherosome is thick (Fig. 136) along the polar axis, bulging, in the shape of a rounded obtuse cone,

Fig. 136

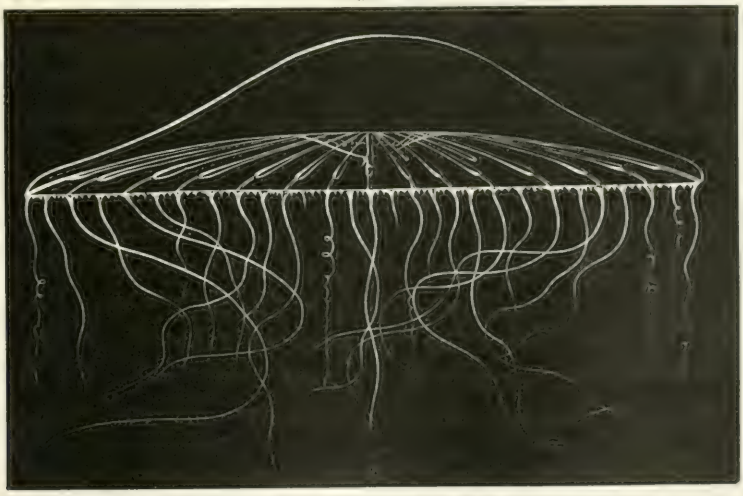
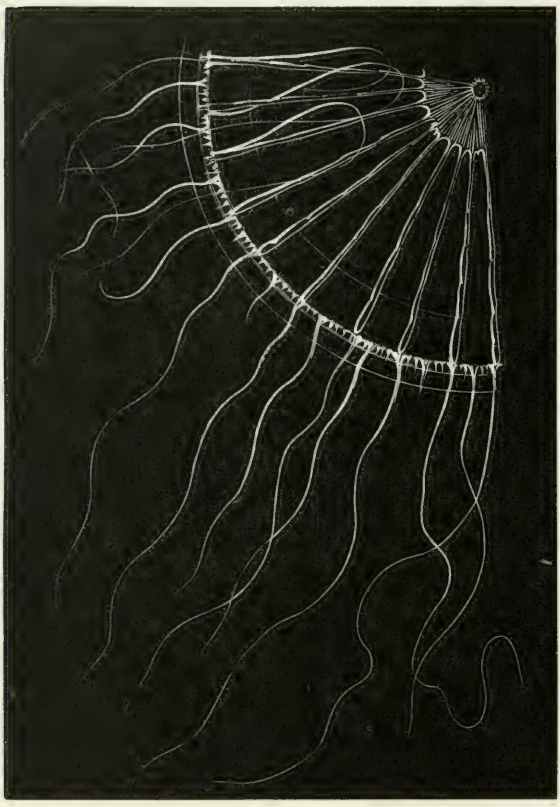


Fig. 136. A profile view, natural size, of Rhegmatodes tenuis.

into the interior cavity; the chymiferous tubes extending nearly to the apex, leaving but a short digestive cavity, the edges of which scarcely meet (Fig. 137), so that, when the actinostome is closed, the lips resemble a piece of catgut tied by a string close to the end; the marginal tentacles are long, generally carried extended, and when contracted twist only two or three times, and are not carried tightly curled, as in Zygodactyla; the ovaries are very narrow, and extend almost the whole length of the chymiferous tubes, from the upper margin of the digestive cavity, to about one tenth the length of the radiating tube from the circular tube; the ovaries hang down in two masses on each side of the chymiferous tubes; there is no connection between the two pouches, except near their point of attachment, where they unite again.

Fig. 137.



Younger specimens, measuring about one and a half to two inches, and not having more than sixteen to twenty-four chymiferous tubes, resemble Stomobrachium; they differ, however, in the small number of tentacles. The marginal capsules are large, elliptical; the granules placed far apart, two in each (*c*, Fig. 138); the tentacles taper rapidly from the base (*t*, Fig. 138), the walls are thin, the lasso cells scattered irregularly over the whole surface. At the base of the large tentacles we find a very prominent projection (*s*, Fig. 138), in the shape of a small tentacle opening into the circular tube; it is not exactly a spur, as in Lafœa; it develops only after the rudimentary tentacles, being a button scarcely to be recognized when the tentacle is already quite well formed; there are usually only rudimentary tenta-

Fig. 138.

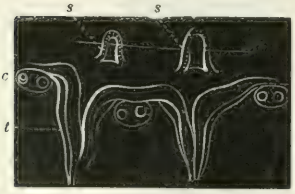


Fig. 137. Quarter of the disk of Fig. 136, seen from the actinal side.

Fig. 138. A magnified portion of the circular canal, showing the position of the spur of the tentacles, *s*, *s*, and of the marginal capsules, *c*, between the tentacles, *t*.

cles between the chymiferous tubes, except one large tentacle in the middle of the space; there is always one marginal capsule between the adjoining tentacles. These Medusæ are slow in their movements, allowing themselves to be carried along with the current, after one or two pulsations; they swim near the surface. Found at Naushon in September.

Buzzard's Bay, Naushon (A. Agassiz).

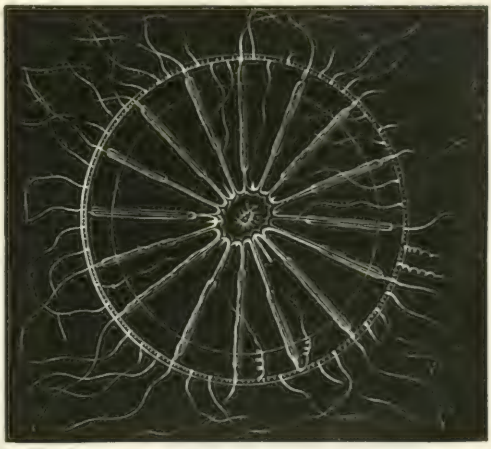
Cat. No. 278, Naushon, September, 1861, A. Agassiz. Medusa.

Rhegmatodes floridanus Agass.

Rhegmatodes floridanus Agass. Cont. Nat. Hist. U. S., IV. p. 361. 1862.

A second species of this genus (Fig. 139) is found along the Florida Reefs. It resembles the young of the northern species at the time when it has from sixteen to twenty-four chymiferous tubes; the part of the gelatinous disk which projects into the interior cavity of the bell is larger, giving the spherosome a somewhat heavy look; the fringes of the actinostome are longer; the ovaries are confined to a small part of the chymiferous tubes, and do not begin at the point of junction of their upper extremity, but a short distance from it; the circular tube is large; in specimens having sixteen chymiferous tubes, there were forty marginal tentacles; in specimens having twenty, there were sixty. This species is much smaller than its northern representative, specimens having already sixteen chymiferous tubes not being more than an inch in diameter; while specimens of the northern species, which have attained the same development, measure about two inches. The marginal capsules contain two to three granules each.

Fig. 139.



Additional chymiferous tubes in the Æquoridæ are developed from the digestive cavity, as has already been shown by Kölliker, and not from the vertical tube, as is the case in the branching tubes of Willia. They are at first simple short sacs, which gradually extend in length till they become long tubes, opening into the circular tube; the chymiferous tubes and the marginal tentacles are not developed with equal regularity, in the order of their cycles; the chymiferous tubes especially are very irregularly formed, and nothing is more common

Fig. 139. Rhegmatodes floridanus, natural size.

than to find specimens having twenty or twenty-two chymiferous tubes, instead of the normal number. The same is the case in the order of development of the chymiferous tubes of Zygodactyla, and the other Æquoridæ which I have had occasion to observe. The tubes are frequently added all on one side of the spherosome, and will be nearly fully formed before they begin to be developed in the other half. The specimens observed of this species are evidently not full-grown, as the ovaries were but imperfectly developed.

Key West, Florida (L. Agassiz).

STOMOBRACHIUM Brandt.

Stomobrachium Br. (*non* Forbes). Prod.; in Mém. Acad. St. Petersb., p. 220. 1835.
Stomobrachium Less. Zooph. Acal., p. 315. 1843.
Stomobrachium Agass. Cont. Nat. Hist. U. S., IV. p. 361. 1862.

Stomobrachium tentaculatum Agass.

Stomobrachium tentaculatum Agass. Cont. Nat. Hist. U. S., IV. p. 361. 1862.
Stomobrachium lenticulare Gould (*non* Br.). Rep. Inv. Mass., p. 349. 1841.
? Medusa bimorpha Fab. Fauna Grönlandica, No. 356. 1781.

This species is occasionally found at Nahant during July. It has twelve chymiferous tubes, a small digestive cavity, the folds of the actinostome hanging down in four lobes, placed at right angles to one another; these lobes are triangular (Fig. 140), the apex of the triangle

Fig. 140.

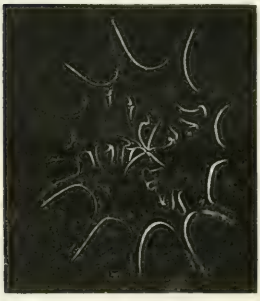
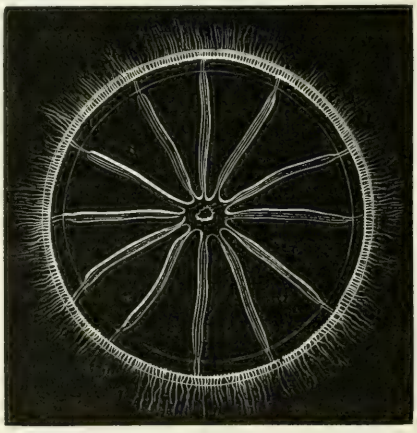


Fig. 141.



being placed nearer the origin of the chymiferous tubes; the edges are frilled; the trend of the triangles is in the direction of four of the chymiferous tubes. Between each two of the chymiferous tubes (Fig. 141) there are from thirty to forty tentacles, in all stages of

Fig. 140. The actinostome of Stomobrachium tentaculatum, magnified to show the peculiar mode of carrying the folds of the digestive cavity.

Fig. 141. Stomobrachium tentaculatum, seen from the abactinal pole; natural size.

development; they are not capable of great expansion, and when shortened, the extremities are curled up. The ovaries, which are linear, extend along the chymiferous tubes in such a way as to leave both the actinal and abactinal extremities free (Fig. 142); the spherosome increases very gradually in thickness from the circular tube towards the abactinal pole. This species differs from the *S. lenticulare* of the Falkland Islands, in having a smaller free area, longer chymiferous tubes, and more numerous tentacles; it grows from one and a half to two inches in diameter, and half an inch in height, is sluggish in its movements, is colorless, and has a gelatinous disk of considerable consistency. These Medusæ are frequently found thrown up on the sandy beaches, encased in sand in such a way as to be preserved from decomposition and loss of shape for several days. This may explain the mode in which the few fossil Medusæ known have been formed.

Fig. 142.

Massachusetts Bay, Nahant (L. Agassiz).

HALOPSIS A. Agass.

Halopsis A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 219. 1863.

The genera Berenix and Carisochroma have been placed by Professor Agassiz among the Williadæ on account of their forking chymiferous tubes. The discovery of Halopsis shows this association to be unnatural, and that most probably, when the genera Berenix and Carisochroma are better known, they will be associated with Halopsis into a distinct family, the Berinicidæ of Eschscholtz. Whatever may be the result, it is at least highly probable that their closer relations are with the Æquoridæ, and not with the Tubularian family of the Williadæ.

Halopsis ocellata A. Agass.

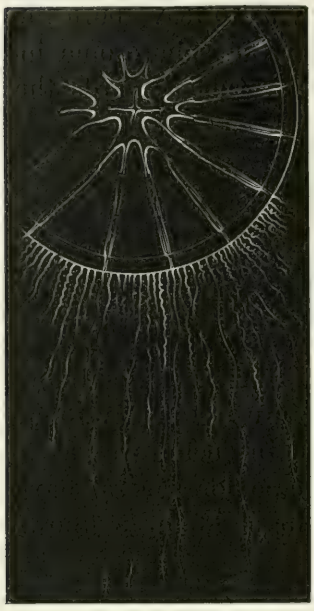
Halopsis ocellata A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 219. 1863.

The genus Halopsis differs from the other Æquoridæ by the presence of large compound eyes, as in Tiaropsis, from three to six between every two of the chymiferous tubes. There are likewise long tentacular cirri; the flatness of the disk, the large number of tentacles, the nature of the digestive cavity and of the genital organs, place this genus among the Æquoridæ. Two species are found on our coast.

Fig. 142. The same as Fig. 141, seen in profile.

which are so closely allied that, were not the complete history of their earlier stages known, they would readily have been mistaken for different ages of the same species.

Fig. 143.



The first species, *Halopsis ocellata*, would at first glance be taken for a Stomobrachium; on examination we find that the chymiferous tubes take their origin in clusters of three to five (in adults), radiating, like the spokes of a fan (Fig. 143), from a large cross-shaped cavity (Fig. 144), from which hangs down a short digestive cavity, terminating in four lips. When seen in profile, the disk is quite flat, regularly arched, the genital organs extend nearly to the circular tube (Fig. 145), occupying almost the whole length of the chymiferous tubes. The tentacles are very numerous, and capable of great expansion and contraction (Figs. 143, 145); there are as many tentacular cirri as tentacles (*c*, Fig. 146); they are long, slender, of uniform diameter; the main tentacles (*t*, *t*, Fig. 146) bulge out prominently immediately at the circular tube, tapering very rapidly. The compound eyes are large (*e*, Fig. 146); the granules in them are arranged in two rows, from six to seven in each row (Fig. 147); the structure of these compound eyes is similar to those of Tiaropsis. These Medusæ are exceedingly sluggish in their movements; they are colorless, the genital organs having a slight grayish tinge at the time of spawning. Found at Nahant, from July to September, quite commonly. In young specimens, measuring not more than an inch in diameter, there are only four chymiferous tubes (Fig. 148), uniting in the form of a cross; there are no signs of genital organs; the shape of the disk is somewhat more hemispherical than in the

Fig. 144.

Fig. 145.

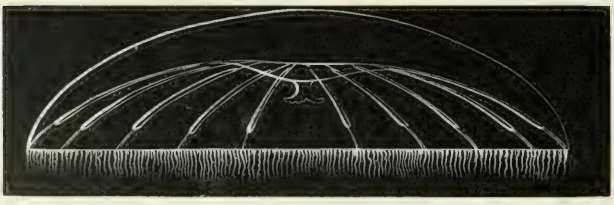


Fig. 143. Portion of the disk of Halopsis ocellata, seen from the abactinal pole, somewhat reduced.

Fig. 144. Cavity from which the chymiferous tubes radiate. *d*, opening of actinostome; *c*, chymiferous tube; *b*, connecting fold between the point of attachment of two chymiferous tubes; *l*, lips of actinostome.

Fig. 145. Profile of Halopsis ocellata; natural size.

adult. Specimens measuring an inch and a half in diameter have as many as twelve chymiferous tubes, the cavity from which the tubes originate being irregularly shaped; it is not till the Medusa measures from two to two and a half inches in diameter, that it takes the regular star-shaped form of Fig. 143; it is then also that the genital organs first appear, like threads on each side of the tubes. Additional chymiferous tubes are formed quite irregularly as diverticula sent off from the digestive pouch, as in other Æquoridæ. It is quite a common thing in this species to have two actinostomes, in specimens where the central cavity is very elongated and irregular in outline, a beginning, perhaps, of a transverse fission similar to that observed by Kölliker in Stomobrachium, but which I have never noticed in our species. In a still younger Medusa (Fig. 149), not measuring more than a fifth of an inch in height, and which I suppose to be the young of this species (it cannot be the young of *Tiaropsis diademata;* see the drawings of the young of that species), we find already four eyes between

Fig. 146.

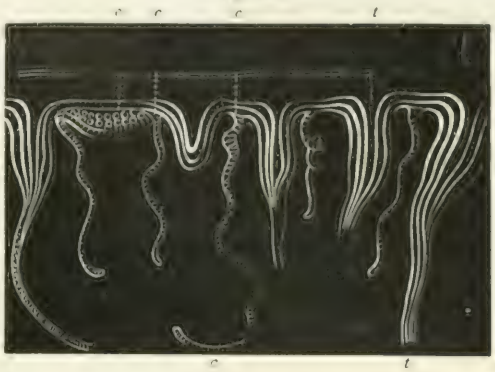


Fig. 149.

Fig. 147.

Fig. 148.

Fig. 150.

two of the chymiferous tubes (Fig. 150), but having only two to three granules in each, one large tentacle at the base of the chymiferous tubes, one in the middle, and rudimentary tentacles of the third set in the intermediate spaces; on each side of these rudimentary tentacles are long cirri; there are no ovaries. It is interesting to see that among the Æquoridæ, the flattest of our Medusæ, the young have a deep bell (Fig. 149), which becomes gradually shallower, as in the other Campanularians. The deep bell of the young Halopsis is totally different from the other form of young Æquorea figured hereafter, which resembles

Fig. 146. Magnified part of circular tube. *c*, tentacular cirri; *e*, compound eye; *t*, main tentacles.

Fig. 147. Magnified view of one of the eyes, to show arrangement of granules.

Fig. 148. Young Halopsis ocellata, natural size.

Fig. 149. Young Halopsis ocellata, a fifth of an inch in height.

Fig. 150. Magnified portion of circular tube of Fig. 149. *c*, *c*, *c*, *c*, cirri; at base of each is placed an eye.

more a Eucope. This may eventually show us two modes of development among the Æquoridæ into forms, forming groups corresponding to those of the Oceanidæ and Eucopidæ as here limited, in one of which the young Medusa has a deep bell and few tentacles, as in Clytia and Oceania, while in the other group they have, when hatched from the reproductive calycles, a flat disk and many tentacles, as in Eucope and Obelia.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 364, Nahant, August, 1862, A. Agassiz. Medusa.

Cat. No. 375, Nahant, 1863, A. Agassiz. Medusa.

Halopsis cruciata A. Agass.

During the early part of the summer there is frequently found a Medusa, at first supposed to be the young of *Halopsis ocellata;* a comparison of the size, the character of the genital organs, and the number of tentacles, shows this to be impossible. *H. cruciata* never grows to more than one and a half to two inches in diameter. The tentacles are much less numerous (Fig. 151), the genital organs are lobed pouches, hanging down in folds from the chymiferous tubes; there are only three compound eyes between every two of the chymiferous tubes; these three eyes are already present in the youngest Medusæ observed, which measure hardly half an inch in diameter, and in which the genital organs are already well developed, while in the young of *H. ocellata*, in specimens measuring nearly two inches, and having as many as twelve chymiferous tubes, we find no trace of them. The bell of these young Medusæ is very high; the eyes differ from those of *H. ocellata*, having only four or five granules arranged in a single row; the tentacular cirri and the large tentacles are essentially the same in both species; the spermaries of the males are quite slender and more linear, compared to the heavily filled, convoluted genital pouches of the females. The genital organs are of a light pink color, as well as the bell.

Fig. 151.

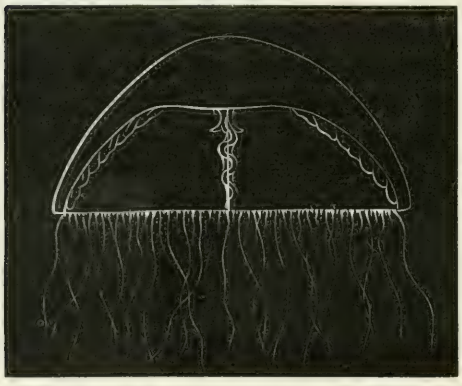


Fig. 152.

Fig. 151. A profile view, somewhat magnified, of Halopsis crucia
Fig. 152. A natural attitude of the same species; both females.

May not the *T. gibbosa* of Forbes be a young Halopsis? They resemble the young of this species; also *T. globosa*, and perhaps *T. pilosella*. We have here again one of those ever-returning questions of the generic identity or difference of species, showing great structural differences, such as we find between these two species; the discovery of the Hydrarium will settle the point. *H. cruciata*, with its high bell (Figs. 151, 152), its four chymiferous tubes, the nature of its compound eyes, and its habits, would seem to be associated with Tiaropsis, among the Oceanidæ; while the tentacular cirri and the arrangement of the compound eyes place it in the closest relationship to *H. ocellata*.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 374, Nahant, 1863, A. Agassiz. Medusæ.

Cat. No. 379, Nahant, June, 1862, A. Agassiz. Medusæ.

Cat. No. 445, Nahant, June, 1864, A. Agassiz. Medusæ.

ZYGODACTYLA Brandt.

Zygodactyla Br. Prod.; in Mém. Acad. St. Petersburg, p. 221. 1835.
Rhacostoma Agass.; in Proc. Bost. Soc. Nat. Hist., III. p. 342. 1850.

Zygodactyla groenlandica Agass.

Zygodactyla groenlandica Agass. Cont. Nat. Hist. U. S., IV. p. 360. 1862.
Æquorea groenlandica Pér. et Les.; in Ann. du Mus., XIV. p. 27. 1809.
Medusa æquorea Fab. Fauna Groenlandica. No. 357. 1780.
Rhacostoma atlanticum Agass.; in Proc. Bost. Soc. Nat. Hist., III. p. 342. 1862.
Æquorea globularis Mörch.; in Besk. af Grönland, p. 96. 1857.
Æquorea groenlandica Less. Zooph. Acal., p. 313. 1843.

This species, of which a short description was given by Professor Agassiz in the Proceedings of the Boston Society of Natural History for 1850, who supposed it to be an undescribed species, is one of the largest of our naked-eyed Medusæ. It is not uncommon to find specimens measuring as much as fifteen inches in diameter when fully extended. There are in full-grown specimens from eighty to a hundred chymiferous tubes (Fig. 153), with three and even four long retractile marginal tentacles between every two chymiferous tubes; the pendent membrane, which forms the digestive cavity, is very contractile, having a circular opening, with short lips and fimbriated edges, corresponding to the chymiferous tubes, which appear to be hardly long enough, when expanded (Fig. 153), to close up the edges, while at other times the lips of the actinostome hang down far below the level of the circular canal, like a sheaf (Fig. 154), and at other times the lips hang down loosely from what seems a small opening, or flare out so as to measure five or six times the diameter of their base. The chymiferous tubes extend a short distance down

the bulging part of the spherosome, the free space left in the centre having a radius of about one third that of the spherosome itself. The lips of the actinostome are formed by the folding of the membrane of the digestive cavity along the direction of the radius; as the membrane becomes more and more fimbriated, the fold becomes deeper and deeper, and projects beyond the general outline, like an exceedingly delicate frill. The tentacles at the base are swollen, taper very suddenly, are hollow (Fig. 155), the walls of the tentacles are thin, and the lasso cells are arranged irregularly over the whole surface in small clusters. At the base of each of the large tentacles there is a small hollow spur (*s*, Fig. 155) projecting inward, the walls of which are thick, and made up of large cells; the rudimentary tentacles are swollen at the extremity, and the spur is not developed until the lash of the tentacle becomes apparent; the marginal capsules are large, ellipsoid, with two large granules in each. In young specimens of Zygodactyla, not having more than forty large chymiferous tubes reaching to the margin, we find the other tubes but slightly developed, two or three sometimes between each of the larger tubes extending from the upper edge of the digestive cavity to various distances from it;

Fig. 153.

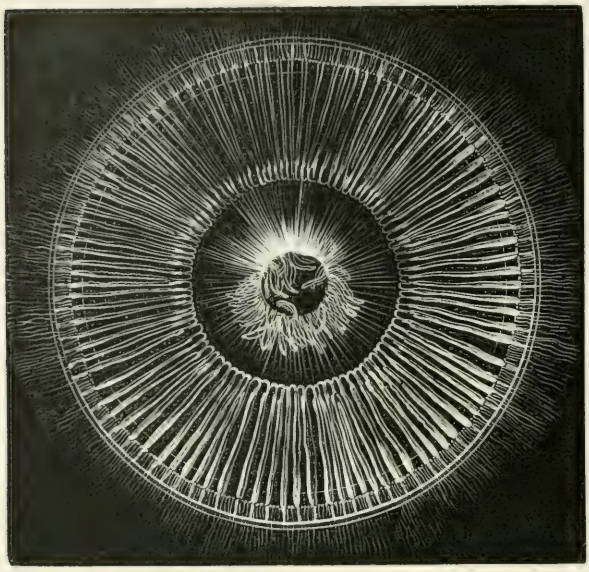


Fig. 154

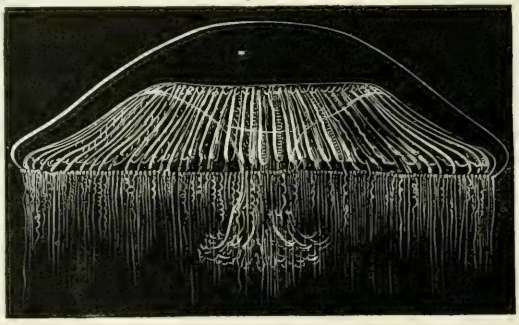


Fig. 155.

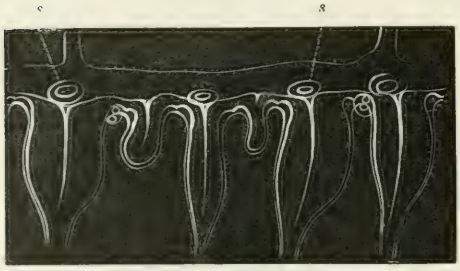


Fig. 153. Abactinal view of Zygodactyla groenlandica.

Fig. 154. Profile view of Fig. 153, half natural size.

Fig. 155. Portion of the circular tube, showing the mode of development of the marginal tentacles. *s*, spur of marginal tentacles.

these rudimentary tubes are mere threads, running a short distance, and then suddenly terminating, or tapering gradually to a point. In the latter part of June, or early in July, the Zygodactylæ are all in this condition, while later in the season, in August and the latter part of September, they attain their full size, all the chymiferous tubes being about equally developed. The lips of the actinostome are so readily movable that the outline of its edge will assume the most varied shapes, the opening being either concentric and perfectly circular, or else thrown entirely to one side, or assuming a pear-shaped form, closing at another time like the actinostome of an Actinia, and then suddenly spreading into a pentagonal opening; or the membrane of the digestive cavity is expanded to its fullest capacity, extending far below the circular tube, and leaving but a very small elliptical actinostome, from which a sheaf of long, slender, highly fimbriated, lanceolate lips are suspended.

Notwithstanding the facility with which this species is kept alive, I have never succeeded in raising the eggs, as is so easily done with Tima and Melicertum, and can therefore add nothing to the observations of Wright on the Hydrarium of *Æquorea vitrina*.

Among the numerous young Eucopidæ, daily examined, are frequently found exceedingly small Medusæ, not larger than the head of a pin, which I suppose to be the young of Zygodactyla. They resemble the Eucopidæ, but differ in having rather more slender tentacles, and a very peculiar gelatinous projection of the disk, at the base of which are situated four round genital organs (Fig. 156); there are four chymiferous tubes opening into a large cavity, leading into a slightly pendent stomach, exactly as would be the case in a Zygodactyla, if we were to reduce the chymiferous tubes to four, and make the genital organs round. The youngest Medusæ have already twenty-four tentacles, and the next size, scarcely larger, forty-eight; from this large number of tentacles, as well as the peculiar projection of the gelatinous disk, and the large cavity from which the chymiferous tubes take their origin, I have but little doubt that they are the young of Æquoridæ, probably of our Zygodactyla. The small size of these Medusæ, coupled with their habit of living at the bottom, till late in the fall, when they make their appearance as full-grown Medusæ, will readily account for their having escaped our notice thus far. These young Æquoridæ are quite common early in June; their further development could not be traced, as they do not thrive in confinement.

Fig. 156.

Fig. 156. Young Zygodactyla, greatly magnified.

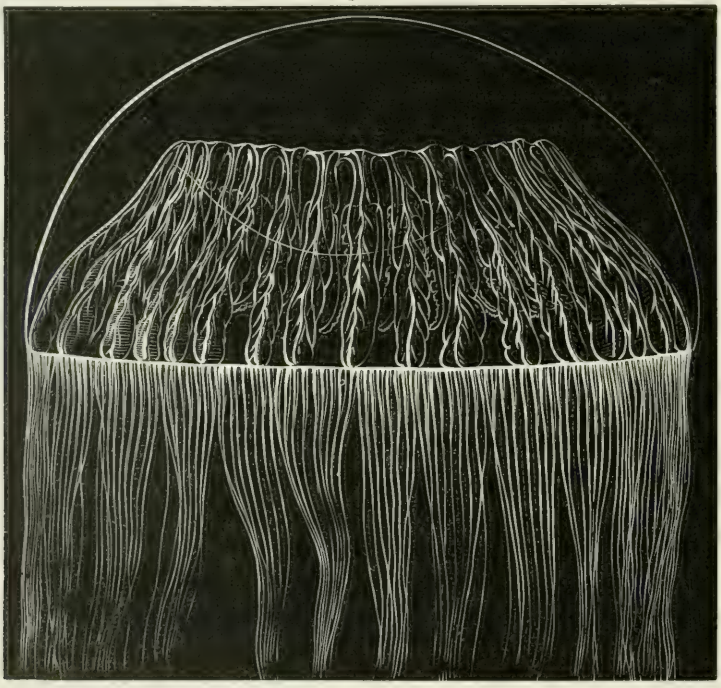
Greenland (Fabricius); Maine, and Massachusetts Bay (L. Agassiz); Naushon (A. Agassiz).

Cat. No. 277, Naushon, September, 1861, Alex. Agassiz. Medusa.

Zygodactyla crassa A. Agass.

This species, which grows to almost as large a size as *Zygodactyla groenlandica*, can be recognized at first glance by the small number and great size of the genital organs; there are not more than thirty-two chymiferous tubes (Fig. 158) in a Medusa measuring ten inches in diameter, while in a specimen of *Z. groenlandica* of the same size we should find at least eighty to ninety; the ovaries have an extraordinary development, and bulge out at the time of spawning fully as much as the ovaries of Melicertum, hanging very much in the same

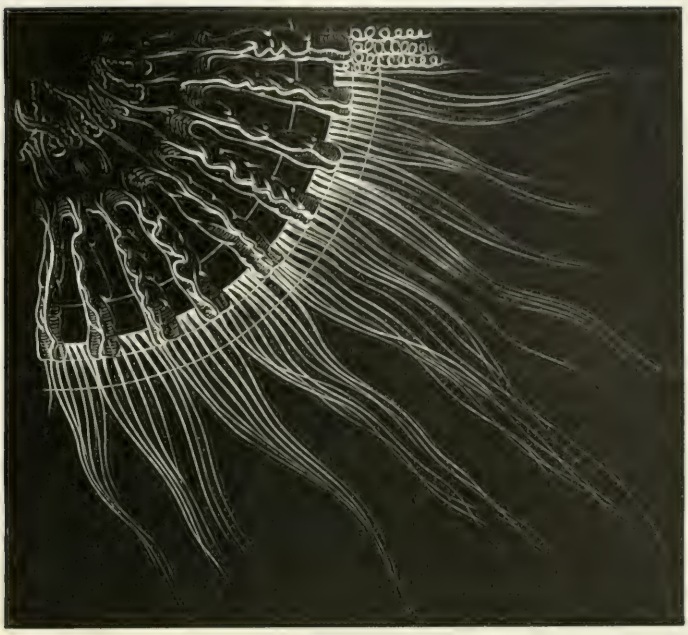
Fig. 157.



manner from the chymiferous tubes (Fig. 157); the radius of the digestive cavity is larger; the number of lips of the actinostome corresponds to that of the radiating tubes (Fig. 158); the digestive cavity is far less capable of expansion and contraction than in *Z. groenlandica;* the marginal tentacles are much heavier and more massive; the color of the base is slightly greenish-blue, as well as the genital organs; the latter have a rather more yellowish hue. Found at

Fig. 157. Profile view of Zygodactyla crassa, somewhat reduced in size.

Fig. 158.



Nahant, in company with the *Z. groenlandica*. The color of the males is somewhat more pinkish than that of the females.

Massachusetts Bay, Nahant (A. Agassiz).

Zygodactyla cyanea Agass.

Zygodactyla cyanea Agass. Cont. Nat. Hist. U. S., IV. p. 361. 1862.

Fig. 159.

This species is of a light-blue color; can readily be distinguished from *Z. groenlandica* by the great thickness of the spherosome, and the large digestive cavity; the actinostome is bordered by a number of very small and finely fimbriated lips (Fig. 159); the chymiferous tubes do not curve down and extend along the projection of the spherosome in the inner cavity of the bell; at their highest point they empty into the digestive cavity, the radius of which is more than one half that of the spherosome itself, leaving but a short space between the abactinal edge of the digestive cavity and the circular tube; the chymiferous tubes are numerous, ninety to a hundred, usually placed opposite a long and exceedingly contractile tentacle; these are generally

Fig. 158. Quarter of the disk of Z. crassa.
Fig. 159. Portion of the disk of Zygodactyla cyanea, from the abactinal pole.

carried curled tightly to the edge of the disk. Found in great numbers, from February to May, along the Florida Reef.

Florida, Key West (L. Agassiz).

Cat. No. 349, Florida, L. Agassiz. Medusa.

Cat. No. 350, Tortugas, Fla., May, 1858, L. Agassiz. Medusa.

Zygodactyla cœrulescens Br.

Zygodactyla cœrulescens Br.; in Mém. Acad. St. Petersb., p. 360, Pl. 5. 1838.
Zygodactyla cœrulescens Agass. Cont. Nat. Hist. U. S., IV. p. 360. 1862.
Mesonema cœrulescens Br.; in Mém. Acad. St. Petersb., p. 360. 1838.
Mesonema cœrulescens Less. Zooph. Acal., p. 307. 1843.

Entrance of Straits of Fuca (A. Agassiz).

CREMATOSTOMA A. Agass.

Crematostoma A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 360. 1862.

The genera of Æquoridæ found on the Pacific coast are either identical with those of our coast, or have representatives which give to the members of that family found on the two sides of the continent a striking similarity. Stomobrachium, Zygodactyla, and Æquorea are found both in the Atlantic and Pacific; we have Rhegmatodes, which has as yet no representative on the Pacific coast of North America, while Crematostoma has not been found on the Atlantic side.

This genus recalls Zygodactyla, in having a large digestive cavity; it is, however, much less contractile than in that genus, and hangs always far below the level of the circular tube. The actinostome, as in Zygodactyla, is surrounded by a number of narrow, lanceolate, fimbriated lips, one for each chymiferous tube, which are from sixty to eighty in number.

Crematostoma flava A. Agass.

Crematostoma flava A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 360. 1862.

The lower part of the digestive cavity, immediately above the actinostome, is alone capable of considerable contraction, the digestive cavity hanging down like a large cylindrical sac, with numerous longitudinal folds extending from the origin of the chymiferous tubes along the whole length of the sac to the actinostome. The chymiferous tubes are broad, extending a short distance along the projection of the spherosome into the cavity of the bell. The ovaries extend the whole

length of the chymiferous tubes, they are linear (Fig. 159ª); opposite each of the chymiferous tubes there is one large tentacle, very contractile, with a slight swelling at the base; between the chymiferous tubes, one smaller tentacle and marginal capsules; the chymiferous tubes, near the base of the digestive cavity, anastomose frequently; the section of the spherosome resembles that of Zygodactyla more than any other genus of the family. The disk increases rapidly from the circular tube, and remains then of the same thickness to the base of the projection of the disk in the inner cavity; here the outline of the inner bell suddenly curves down, and projects like a spherical segment, nearly hemispherical, in the cavity of the bell, the outline of the outer bell having a slight constriction at this point, and from there curving gradually to the abactinal pole. From three to four inches in diameter; specimens one and a half inches high, measured three and a half inches in diameter.

Fig. 159ª.

Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 123, Gulf of Georgia, W. T., June, 1859, A. Agassiz. Medusa.

ÆQUOREA Pér. et Les.

Æquorea Pér. et Les.; in Ann. du Mus., p. 22. 1809.
Æquorea Less. (*p. p.*). Zooph. Acal., p. 305. 1843.
Æquorea Agass. Cont. Nat. Hist. U. S., IV. p. 359. 1862.

Æquorea ciliata Esch.

Æquorea ciliata Esch. Syst. der Acal., p. 109, Pl. 9, Fig. 1. 1829.
Æquorea ciliata Agass. Cont. Nat. Hist. U. S., IV. p. 359. 1862.
Æquorea ciliata Less. Zooph. Acal., p. 306. 1843.

Northwest Coast of North America, Lat. 41° to 51° N. (Eschscholtz); Straits of Fuca (A. Agassiz).

Fig. 159ª. Crematostoma flava A. Agass.

Æquorea albida A. Agass.

Æquorea albida A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 359. 1862.

The genus Æquorea, as generally received, includes species which have been separated from it, under the name of Zygodactyla, by Brandt, and to which the *Æquorea vitrina* of Gosse also belongs. The long pendent membrane of the digestive cavity, with the actinostome surrounded with numerous lanceolate and strongly fimbriated folds, at once distinguishes this genus from Rhegmatodes, which includes such species as *Rhegmatodes tenuis* and *floridanus*, and the *Æquorea forbesiana* of Gosse, in which the chymiferous tubes are not numerous, the tentacles few in number, and the digestive cavity not capable of extension as in Zygodactyla, the lips of the actinostome being short and simple folds. Æquorea is distinguished from both these genera by having a greater number of chymiferous tubes, the ovaries extending for their whole length, from the circular tube to the membrane of the digestive cavity. The tentacles are numerous, the spurs at the base of the large tentacles being more closely connected with them than in the other genera of this family. The actinostome is a simple opening, without appendages such as we find in Zygodactyla, Stomobrachium, and others, having only slight indentations formed along its margin, giving the opening a somewhat polygonal shape (Fig. 160); and when entirely closed, the edges of the actinostome meet, forming a slight button. The spherosome has a slight indentation near the abactinal pole, the bell diminishing very gradually in thickness towards the circular tube (Fig. 161); the gelatinous disk hardly projects into the cavity of the bell; the chymiferous tubes run into the digestive cavity at their highest point, the radius of the digestive cavity being about one third that of the spherosome; the chymiferous tubes are narrow, there are three or four marginal tentacles between every two chymiferous tubes, and two or three

Fig. 160.

Fig. 161.

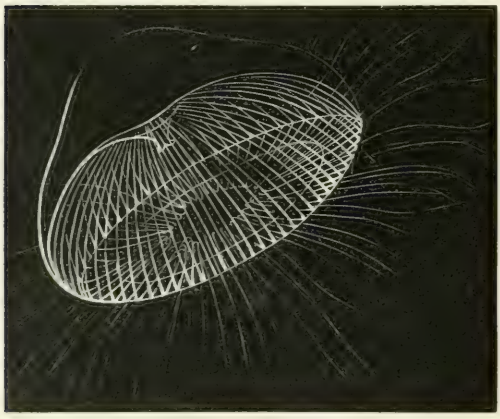


Fig. 160. A portion of the disk of Æquorea albida, from the abactinal pole.
Fig. 161. A natural attitude of Æquorea albida.

marginal capsules, two for every large tentacle, between the tubes, in each of which there are from three to four granules arranged in a cluster in the centre; the capsules are perfectly spherical (*c*, Fig. 162); the walls of the tentacles taper very gradually from the circular tube, the swelling has but little prominence, and the pigment cells at their base are not numerous, scarcely coloring it; the lasso cells are arranged in small knobs, scattered, at some distance from one another, all over the surface of the tentacles; the spur of the tentacles (*s*, Fig. 162) is placed directly opposite the large tentacle on the other side of the circular tube; the walls of this spur are thick, and its hollow space appears like a small elliptical opening when seen from above; the undeveloped tentacles are solid conical protuberances, from which the cavity of the tentacle is little by little hollowed out; the tentacles are usually carried tightly twisted like a corkscrew; when in motion, the tentacles are fully expanded, then bent at right angles and drawn inside the veil and slowly thrown out, the tentacles almost closing the opening of the cavity of the bell, giving these Medusæ the appearance of having numerous long tentacles (Fig. 161) arising from a small circular tube, the chymiferous tubes and the tentacles in their prolongation making almost a complete sphere. Specimens from one to two and a half inches in diameter were taken at Naushon during September.

Fig. 162.

Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 279, Naushon, Mass., Sept. 1861, A. Agassiz. Medusa.

Fig. 162. Magnified view of part of the marginal tube. *c*, capsule; *s*, spur of the tentacles, *t*.

Family GERYONOPSIDÆ Agass.

Geryonopsidæ Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.
Geryonidæ Esch. (*p. p.*). Syst. der Acal., p. 86. 1829.

EIRENE Esch.

Eirene Esch. Syst. der Acal., p. 94. 1829.
Geryonopsis Forbes. Naked-eyed Medusæ, p. 39. 1848.
Phortis McCr. Gymn. Charl. Harb., p. 90.
Eirene Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.

Eirene gibbosa Agass.

Eirene gibbosa Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.
Phortis gibbosa McCr. Gymn. Charl. Harb., p. 91.

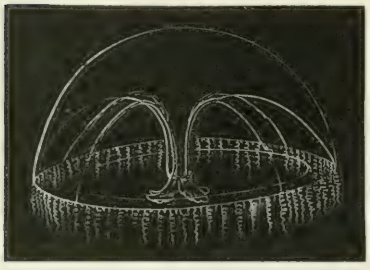
Charleston Harbor (McCrady).

Eirene cœrulea Agass.

Eirene cœrulea Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.

The spherosome increases rapidly in thickness from the circular tube to the peduncle, which tapers quickly, and when fully expanded does not reach much beyond the level of the veil (Fig. 163); the ovaries are linear, slightly convoluted, do not extend the whole length of the chymiferous tubes, but begin about halfway up, between the circular tube and the base of the peduncle, extending close to the digestive sac, which is terminated by four short lips with slightly fimbriated edges; the outline of the spherosome is hemispherical; the tentacles are numerous, in the largest specimens measuring an inch and a quarter across the disk, and an inch in height; there were as many as thirty to thirty-five short tentacles between every two chymiferous tubes; the gelatinous disk has a slight tinge of blue. Found at Key West and the Tortugas in April.

Fig. 163.



Florida, Key West (L. Agassiz).

Fig. 163. Eirene cœrulea.

TIMA Esch.

Tima Esch. Syst. der Acal., p. 103. 1829.
Eirene Esch. (*p. p.*). Syst. der Acal., p. 94. 1829.
Dianæa Delle Ch. Mem. sulla Storia e Notomia. 1823–29.
Tima Less. Zooph. Acal., p. 333. 1843.
Tima Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.

Tima formosa Agass.

Tima formosa Agass. Cont. Nat. Hist. U. S., IV. p. 362. 1862.

Spherosome greater than a hemisphere, with edges slightly receding from the polar axis, near the circular tube. The disk increases in thickness very gradually to the bend of the chymiferous tubes (Fig. 164), where the gelatinous disk extends in a broad cone, slowly diminishing in diameter, till it reaches somewhat beyond the level of the veil. This peduncle is contractile, extending at times the diameter of the inner cavity of the bell beyond the circular tube; the sexual organs

Fig. 164.

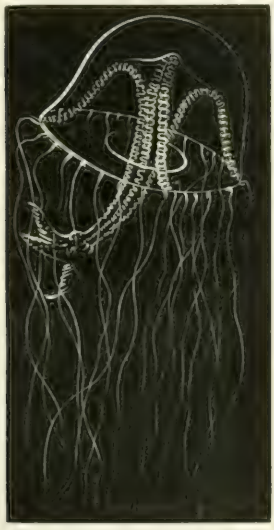


Fig. 165.

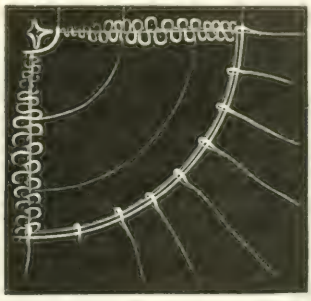


Fig. 166.

extend from the circular tube (Fig. 165) the whole length of the chymiferous tubes, and nearly to the end of the peduncle: the four chymiferous tubes open into a short digestive cavity (*c*, Fig. 166); the actinostome is surrounded by four very slender, long, lanceolate, fimbriated lips. (*l*, Fig. 166.) There are thirty-two long contractile tentacles, seven between every two chymiferous tubes, and one opposite each tube; the ovaries consist of series of little pouches hanging down on

Fig. 164. Tima formosa, half natural size.
Fig. 165. Quarter-disk, from the abactinal pole; natural size.
Fig. 166. Digestive cavity and actinostome. *t*, termination of chymiferous tube; *c*, digestive cavity; *l*, one of the four fimbriated lips of the actinostome.

both sides of the chymiferous tubes (Fig. 167); the tentacles have a very prominent pouch, strongly compressed laterally, at the point of junction with the marginal tubes; between the larger principal tentacles (*t*, Fig. 168) we find a number of small pouches, rudimentary tentacles (*t'*, Fig. 168), which are never developed fully, yet appear to be included in the regular cycle of tentacles, to judge from the number we find at different stages of growth; between the smaller tentacles we find marginal capsules (*c*, Fig. 168), with four to five granules arranged near the periphery; the circular tube is large and very prominent; the spherosome is perfectly colorless, but the ovaries, as well as the base of the tentacles, are of a beautiful milky white, which makes these Jellyfishes a very prominent object in the water; they do not come near the surface, but remain usually four or five feet below; they are found during the whole year, adult specimens having been taken in June, October, December, and March. The young Medusa (Fig. 169) differs widely from the adult; there are no ovaries in specimens measuring more than an inch in diameter; the chymiferous tubes extend along the short proboscis (*t*, Fig. 170), opening into a digestive cavity, *d*, which terminates with four rather simple lips, more like the actinostome of a Lafœa; there are but three large marginal tentacles between adjoining chymiferous tubes, and no signs of any further cycles of tentacles in the specimen figured here; marginal capsules were likewise not yet developed. The young Medusa of Tima is another case to be added to Melicertum, Lafœa, and Atractylis, where there are no marginal

Fig. 167.

Fig. 168.

Fig. 169.

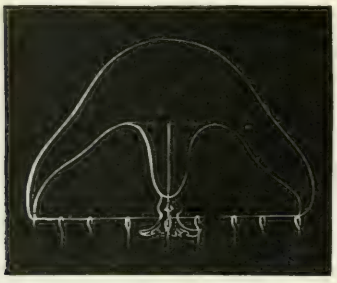


Fig. 170.

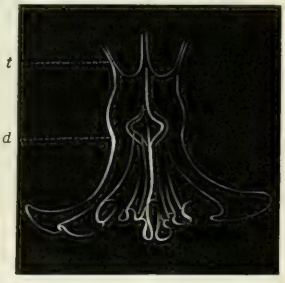


Fig. 167. Portion of the ovary. *f*, *f*, lobes running on either side of the chymiferous tubes.

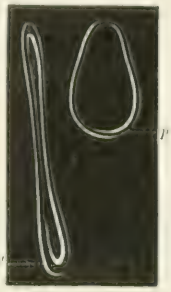
Fig. 168. A magnified portion of the circular tube. *t*, *t*, principal tentacles; *t'*, rudimentary tentacles; *c*, marginal capsules

Fig. 169. Young Tima formosa, natural size.

Fig. 170. Digestive cavity of Fig. 169. *t*, termination of chymiferous tubes; *d*, digestive cavity.

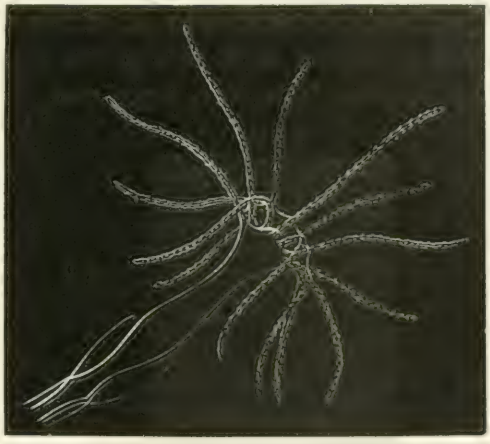
capsules along the circular tube, and yet these Medusæ have all been traced to a Campanularian-like Hydrarium. Tima differs from the other genera just mentioned, in developing eventually these marginal capsules, which are always wanting, at least in the shape of capsules with limestone concretions, in the above-mentioned genera. See the magnified portion of the circular tube of Tima (Fig. 168), and compare this, crowded with marginal capsules, to the circular tube of Melicertum and Lafœa. Having kept in confinement males and females of this species, I succeeded in raising from the eggs the Planula, and ultimately the Hydrarium, as in the case of Melicertum, where further details will be found concerning the mode of development of the Planula into the Hydrarium; as this is identical in both, I shall only describe the Planula and Hydrarium as far as they differ from those of the Melicertum.

Fig. 171.



The Planula is more pear-shaped (*p*, Fig. 171) than that of the Melicertum, and takes a far greater elongation before attaching itself. (*p'*, Fig. 171.) The Hydrarium is also more slender, the cup is more distinct, the tentacles are quite long and slender, and are connected at the base by a web (Fig. 172); this seems to be a mere embryonic feature, as I have noticed the same web in several young Campanularians. The Hydrarium here figured attained its present features at the end of six months. The communities are very small tufts, barely perceptible to the naked eye; they appeared like a few slender threads on the side of the glass vessel in which the Planula was raised; I did not succeed in raising the Hydrarium to observe its further development.

Fig. 172.



Massachusetts Bay (L. Agassiz).

Cat. No. 276, Cape Cod, March, 1862, A. S. Bickmore. Medusa.

Cat. No. 372, Nahant, September, 1863, A. Agassiz. Medusa.

Museum Diagram No. 17, after A. Agassiz.

Fig. 171. *p*, young planula; *p'*, planula immediately before attaching itself.

Fig. 172. Single Hydra of the tuft of a Tima Hydrarium, greatly magnified.

EUTIMA McCr.

Eutima McCr. Gymn. Charl. Harbor, p. 87.
Eutima Agass. Cont. Nat. Hist. U. S., IV. p. 363. 1862.

Eutima mira McCr.

Eutima mira McCr. Gymn. Charl. Harb., p. 88, Pl. 11, Figs. 8, 9.
Eutima mira Agass. Cont. Nat. Hist. U. S., IV. p. 363. 1862.

Charleston, S. C. (McCrady).

Eutima variabilis McCr.

Eutima variabilis McCr. Gymn. Charl. Harb., p. 88.
Eutima variabilis Agass. Cont. Nat. Hist. U. S., IV. p. 363. 1862.

Charleston, S. C. (McCrady).

Eutima limpida A. Agass.

Eutima limpida A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 363. 1862.

This species (Fig. 173) resembles closely the *Eutima mira* of Charleston Harbor; like it, it has only four long tentacles (with one short cirrus on each side of the tentacle, Fig. 176), one opposite each chymiferous tube, two large marginal capsules between each two ten-

Fig. 173.

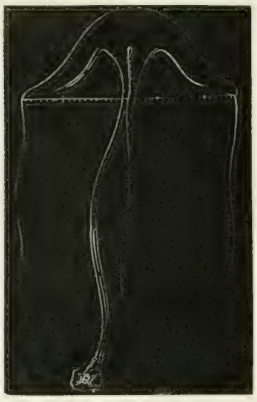
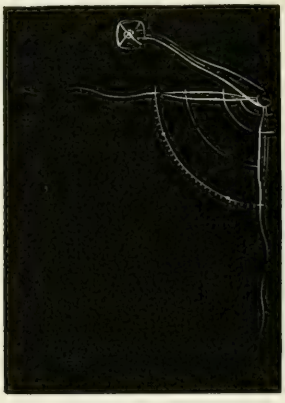


Fig. 174.



tacles (Fig. 174), arranged at equal distances round the marginal tube, and a number of rudimentary tentacles which are never further developed. The gelatinous part of the disk, which projects in the proboscis (*g*, Fig. 175), is shorter than in the Charleston species; it does not extend much more than the height of the bell beyond the level of the veil; the tentacles also are shorter, and have no swelling; the diges-

Fig. 173. Profile of Eutima limpida, reduced in size.
Fig. 174. Quarter-disk of Fig. 173.

tive cavity (*c*, Fig. 175) is very short; it is situated at the extremity of the narrow flexible sac, extending from *g* to *c*, Fig. 175, and terminates in a flat quadrangular disk (*d*, Fig. 175), which is sometimes folded in the shape of forceps, although generally kept stretched out flat, like the sucking disk of a leech; in the centre of this disk we find the actinostome, which is a very small rosette-shaped opening, with four loops. The genital glands (*o*, Fig. 175) are narrow; they rise almost from the circular tube, and follow the chymiferous tubes along

Fig. 175.

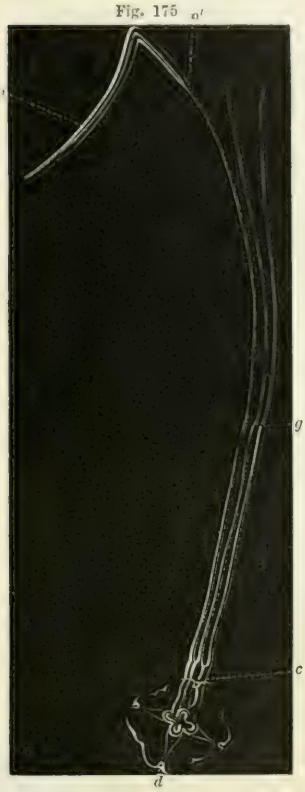


Fig. 176.

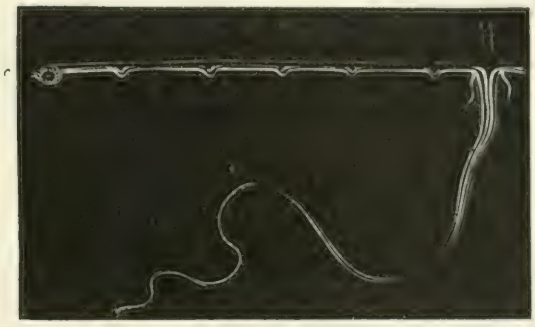


Fig. 177.

Fig. 178.

the gelatinous prolongation of the disk, nearly to the level of the veil. (*o'*, Fig. 175.) The tentacles are hollow and have no swelling at the base (Fig. 176), the walls being thicker and tapering gradually to the extremity. In the marginal capsules (Fig. 177), which are so large that they can be seen with the naked eye, there are from twelve to thirteen granules arranged in a circle near the periphery of the capsule. The rudimentary tentacles (*t*, Fig. 178) are mere triangular expansions

Fig. 175. Magnified view of the proboscis and genital organs. *g*, terminal point of gelatinous prolongation of the disk; *o*, part of genital organs extending along the bell; *o'*, terminal point of genital organs along the gelatinous prolongation of the bell; *c*, digestive cavity; *d*, actinostome in its usual mode of expansion.

Fig. 176. Magnified portion of the circular canal, with a primary tentacle and tentacular cirri, to show the rudimentary tentacles between the chymiferous tubes and the capsules, *c*.

Fig. 177. Magnified marginal capsule, showing the circular arrangement of the granules.

Fig. 178. Still more magnified view of the rudimentary tentacles. *c*, circular tube; *t*, rudimentary tentacles.

of the circular tube, *c*. The bell widens very rapidly towards the lower floor, and is perfectly transparent; the ovaries, as well as the tentacles and the proboscis, are colorless; the diameter of the bell is nearly two inches, and the polar diameter about half an inch; the proboscis is usually carried as in Fig. 173, and, as the digestive cavity is capable of but slight contraction, it bears usually the proportions of that figure to the diameter of the bell. Found in Buzzard's Bay during September.

Buzzard's Bay, Naushon (A. Agassiz).

Eutima pyramidalis Agass.

Eutima pyramidalis Agass. Cont. Nat. Hist. U. S., IV. p. 363. 1862.

The spherosome is hemispherical, and more heavy than in either *Eutima limpida* or *E. mira;* the proboscis is shorter, and tapers rapidly; the tentacles are short; the oral leaflets are rounded and separated by an indentation from one another, the edge of the leaflets being finely scalloped; the digestive cavity is short.

Florida, Key West (L. Agassiz).

Family POLYORCHIDÆ A. Agass.

Polyorchidæ A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 349. 1862.

This family is characterized by the peculiar structure of the chymiferous tubes, which, sending off diverticula at right angles to the main tube, give these Medusæ a very peculiar aspect. With the exception of Polyorchis, we know of only one other genus, Olindias Fr. Müll., which has the same structure of the chymiferous tubes. Müller, at the close of his description of *O. sambaquiensis*, says it is characteristic of the uncertainty which still exists in the classification of Acalephæ, that the attempt to assign to this Medusa its position in the systems of Eschscholtz, Forbes, or Lütken, places them in families with which they have no affinities, and we cannot even assign them to any of the families of Gegenbaur; the only genus to which it seems to have any relation is Melicertum Oken. This suggestion of Müller, as to the affinities of his genus Olindias, is fully borne out by the examination of the *Melicertum penicillatum* of Eschscholtz, which has, like it, peculiar chymiferous tubes, and also the discovery of Gonionemus, a genus having the general appearance of Olindias without the ramifying chymiferous tubes. Gonionemus shows us the close relation that exists between these genera and Melicertum, although the differences existing between Olindias and Polyorchis on one side, and Gonionemus and Melicertum on the other, are such as to form very natural families.

POLYORCHIS A. AGASS.

Polyorchis A. AGASS.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 349. 1862.
Melicertum ESCH. (*p. p.*). Syst. der Acal., p. 105. 1829.

Polyorchis penicillata A. AGASS.

Polyorchis penicillata A. AGASS.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 349. 1862.
Melicertum penicillatum ESCH. Syst. der Acal., p. 106, Pl. 8, Fig. 4. 1829.
Aglaura penicillata BL. Man. d'Actinol., Pl. 33, Fig. 4.
Melicertum penicillata LESS. Zooph. Acal., p. 293. 1843.

This strange Jelly-fish I first found in great numbers, while becalmed at the entrance of the Straits of San Juan de Fuca, in October, in company with large numbers of a Medusa which I suppose to be the *Mesonema* (*Zygodactyla*) *cœrulescens* found by Brandt in the latitude of San Francisco, and which I had afterwards occasion to observe again near Punta de los Reyes, about twenty miles northwest of San Francisco. It is also quite common in the harbor of San Francisco during the winter months. It combines the characters of several families, has the long, pendent digestive cavity of the Thaumantiadæ (Fig. 179); the ovaries hang independently, four in number to each chymiferous tube (Fig. 180), near the base of the digestive cavity, as in the Trachynemidæ. But what is very peculiar is the structure of the chymiferous tubes; instead of being simple or forking tubes, as we generally find in the Hydroids, they remind us of the structure of the chymiferous tubes in Idyia, sending off short shoots into the gelatinous disk at right angles, alternat-

Fig. 180.

Fig. 179.

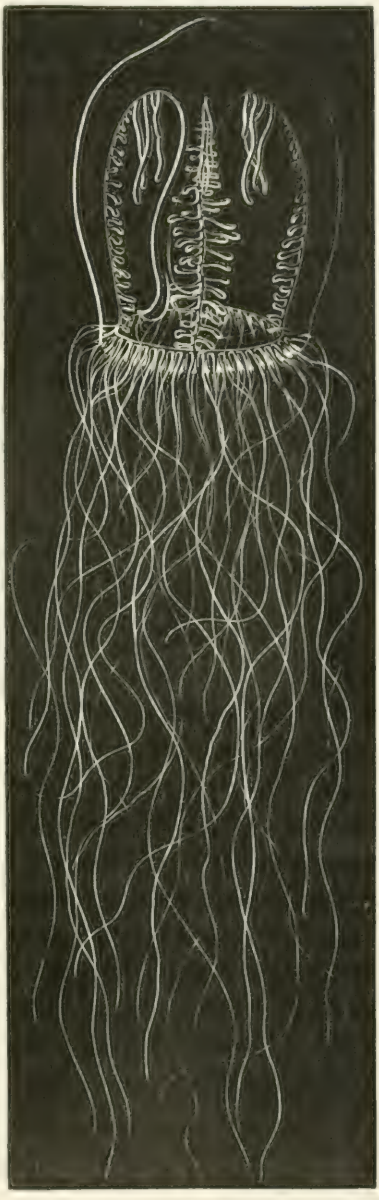


Fig. 179. A profile view, somewhat magnified, of Polyorchis penicillata.
Fig. 180. Ovaries of one of the chymiferous tubes.

ing with each other (Fig. 179); this gives to these Medusæ a very peculiar appearance, differing entirely from any other family of Hydroids, and for which I would propose the name of Polyorchidæ. The polar axis is the longest; the spherosome has its greatest width at the level of the ovaries (Fig. 179); from this point it turns rapidly towards the abactinal pole, while it scarcely tapers towards the actinostome, giving the spherosome the appearance of a cylinder with a rounded top; the thickness of the spherosome is very uniform, projecting but slightly in the inner cavity of the bell (Fig. 181), at the point of attachment of the digestive cavity; the digestive cavity is long, slender, and exceedingly movable, terminating in four lobes (Fig. 182), and extending to the opening of the veil; there are four genital organs of unequal length, attached at the highest point (Fig. 180) of the four chymiferous tubes, hanging freely in the cavity of the bell; they are arranged one behind the other, along the upper extremity of the chymiferous tubes, the longest equalling half the height of the inner bell. The diverticula from the main tubes commence immediately at the base of the ovaries, where they are quite small; they gradually increase in size for about half the length of the chymiferous tubes, whence they continue nearly of the same size to the

Fig. 181.

Fig. 182

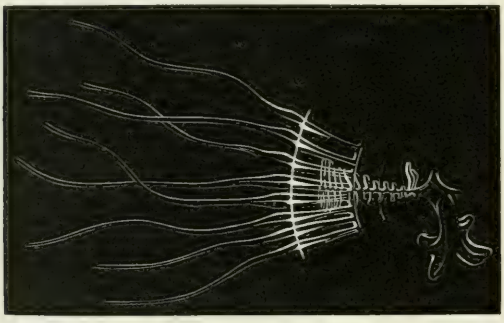


Fig. 183.

circular tube; the offshoots are somewhat more numerous in the lower part of the tube. (Fig. 179.) The tentacles are very contractile (compare Figs. 183 and 179); when drawn up, they are scarcely half the length of the spherosome; they project horizontally from the chymiferous tubes for a short distance, and from the point where a conical dark-purple ocellus is placed are then bent at right angles to their former direction; it is only the lower part of the tentacle which is capable of expansion; when the tentacles are fully expanded, they extend three or four times the length of the bell. The genital sacs, the chymiferous tubes, the tentacles, and the digestive cavity, are of a

Fig. 181. Section of the bell.
Fig. 182. Part of the disk of Fig. 179, seen from the abactinal pole.
Fig. 183. Two of the marginal tentacles in a contracted state.

light reddish-brown color; the bell has a yellowish tint. The motions of this Medusa are rather sluggish; they are very conspicuous in the water on account of their wreath of dark-purple ocelli; they are gregarious, move near the top of the water, the bell almost striking the surface, and when disturbed return to the surface immediately. There are thirty-six tentacles, eight between each of the four chymiferous tubes, and one at the base of each tube; the four lobes of the actinostome are long, and flare out considerably beyond the diameter of the digestive cavity, which is of a uniform length, widening very gradually to the point of junction with the chymiferous tubes; the main chymiferous tubes are slightly winding; the lower knotty, club-shaped diverticula have a tendency to bend downwards towards the circular tube; the veil is narrow; the ovaries are one third the length of the spherosome. These Jelly-fishes attain a height of nearly two inches; but smaller specimens, measuring only an inch in height, showed, except the size, no differences; the character of the marginal capsules of this Medusa, if there are any, has not been examined.

This is undoubtedly the *Melicertum penicillatum* of Eschscholtz, though from his description and figures the characteristic features of this Medusa are not very evident.

California (Eschscholtz); Gulf of Georgia (A. Agassiz); San Francisco, Cal. (A. Agassiz).

Cat. No. 283, San Francisco, Cal., Dec. 1859, A. Agassiz. Medusa.
Cat. No. 284, San Francisco, Cal., Jan. 1854, T. G. Cary. Medusa.
Cat. No. 285, Gulf of Georgia, W. T., 1859, A. Agassiz. Medusa.

Family LAODICEIDÆ Agass. (*emend.* A. Agass.).

Laodiceidæ Agass. Cont. Nat. Hist. U. S., IV. p. 350. 1862.
Thaumantiadæ Gegenb.; in Zeit. f. Wiss. Zool., p. 236. 1856.

The family name of Laodiceidæ given to the Thaumantiadæ Gegenb. by Professor Agassiz, may, in its turn, yield to that of Lafœadæ, should it be found that the Hydrarium of Laodicea Less. is invariably a Lafœa. The name Laodiceidæ is here retained, as the Medusæ, associated under that generic name, present differences which, when the Hydrarium becomes known, may warrant our retaining the name Laodicea for some of them, and thus the genus which has given the family name may still be retained, even if for the present we substitute for some of the species of Laodicea the older name of Lafœa of Lamouroux. The Laodiceidæ are here extended to include the Melicertidæ, which certainly are closely related, and can hardly be divided into distinct families, if we are to judge from the young Medusæ and the Hydrarium of these genera.

LAFŒA Lamx.

Lafœa Lamx. Expos. Méth. 1812.
Lafœa Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1862.
Lafœa A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 91.
Atractylis Wright; in Ann. & Mag., VIII. p. 129. 1861.
Campanulina Van Ben.; in Bull. Acad. de Belg., XIV. No. 5. 1847.
Laodicea Agass. (*p. p. non* Less.). Cont. Nat. Hist. U. S., IV. p. 350. 1862.

Lafœa calcarata A. Agass.

Laodicea calcarata A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 350. 1862.
Lafœa cornuta Agass. (*non* Lamx.). Cont. Nat. Hist. U. S., IV. p. 351. 1861.
Campanularia dumosa Leidy. Mar. Inv. N. J. and R. I., p. 6.
Lafœa cornuta A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 91, Fig. 4.

The Medusa of Lafœa described in the Contributions of Professor Agassiz, Vol. IV. p. 351, was referred by him to *Lafœa cornuta* of Lamouroux. Having, however, since that time found at Nahant a young Medusa closely allied to the one to be here described, I am inclined to doubt this identification, even though I have not observed its Hydrarium, as I have done for the Lafœa of Naushon; the absence of pigment-spots at the base of the tentacles, and the different number of tentacles at the time when the Medusæ are liberated from the reproductive calycles, easily distinguishes these two Medusæ. The Lafœan Medusa found at Naushon was also followed in its more advanced stages, till we could connect it with the young of the Medusa before described as *Laodicea calcarata*.

Fig. 184.

The largest specimens observed were an inch in diameter; the bell is perfectly transparent (Fig. 184), and, were it not for the four dark-yellowish ovaries, it would readily escape notice; they hang down like short curtains in close folds, extending almost the whole length of the chymiferous tubes, from the digestive cavity where they run into the folds of its base (Fig. 185), to the circular tube; the digestive cavity is short, and the actinostome divides into four thin, convoluted folds, projecting beyond the edge of the digestive cavity to twice its diam-

Fig. 184. Adult Medusa of Lafœa calcarata; magnified.

eter (Fig. 186); the chymiferous tubes are narrow; the tentacles have their greatest diameter directly at the circular tube; they are, however, unequally developed, and vary greatly in character. The large tentacles are very contractile; near the base they have a swelling which consists of small granular cells, with a spot of dark-violet pigment-cells on its lower surface (Fig. 187); on the opposite side of this bulb we find a spur-like projection (see *t*, Fig. 187), consisting of large, transparent, polygonal cells; from this point the tentacle tapers very gradually, and is also made up of larger cells than the basal swelling;

Fig. 185.

Fig. 186.

these cells are arranged in two rows, and through them runs a thin tube to the tip of the tentacle; the lasso cells are numerous, and run in a zigzag manner all over the surface of the large tentacles. When new tentacles are formed in the adult Medusæ, it is the spur which is first developed, and afterwards the swelling with the pigment-cells; the tentacle has then a triangular appearance, and is turned in the opposite direction from the spur; from this time it lengthens very rapidly, though many of the tentacles are never fully developed. There are besides long thread-like tentacles, which are not hollow, and are exceedingly

Fig. 187.

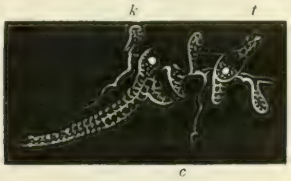


Fig. 188.

contractile (*c*, Fig. 187); in adult specimens they are not distributed regularly, but in young specimens of a quarter of an inch in diameter, having not more than sixteen large tentacles, and sixteen smaller ones (like the large ones) placed between them, we find on the side of each of these sixteen larger tentacles one of these cirri (Fig. 194); but as the number of tentacles increases, the cirri are not formed with the same regularity. We find still a third kind of tentacle: club-shaped

Fig. 185. One of the ovaries and the actinostome.

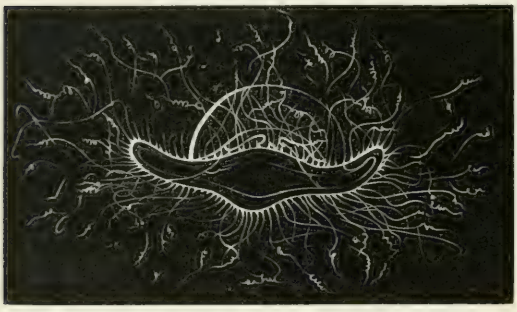
Fig. 186. Actinostome, actinal view.

Fig. 187. Magnified view of a portion of the circular tube. *t*, one of the large tentacles, with spur and pigment-cells; *c*, one of the cirri; *k*, club-shaped appendage.

Fig. 188. Actinostome and rudimentary ovaries of young Medusa, seen in profile.

appendages (*k*, Fig. 187) made up of large polygonal cells, perfectly transparent, one or two sometimes placed between each of the larger tentacles. The large tentacles have the same color as the ovaries. The young Medusæ differ from the adult in the extent of the ovaries, which are limited to the upper part of the chymiferous tubes, close to the digestive cavity (Fig. 188); the ovaries gradually extend further towards the circular tube as they grow older; the digestive cavity is a simple cylinder pressed in, forming small lips; the tentacles also, as described above, are less numerous. The adult Medusa is very active, moving with great rapidity, by drawing its tentacles into the bell, throwing them out again with violence, and allowing itself to be carried along by the momentum it has acquired; twisting its tentacles during that time, and spreading them in every conceivable manner. When it is lazily carried along, the bell often assumes strange attitudes; the thick upper part of the disk becomes rounded, and the thin portion of the umbrella is projected beyond it, like the rim of a four-cornered hat. (Fig. 189.) At other times it seems as if the umbrella had been tied in the middle, the upper and lower part of the disk almost joining in the middle at an obtuse angle. The next moment the disk becomes perfectly flat, the tentacles are drawn up in close knots or shortly-twisted coils, so that it scarcely seems to be the same animal, which in a moment assumes again a globular shape, and darts off to go through the same changes of form.

Fig. 189.



The Medusa in its youngest stage resembles closely the figure given by Wright of the Medusa of *A. repens* in the Edinburgh Philosophical Journal. The Hydromedusarium differs so much, that it does not seem to belong to the same genus as the English species; it is found growing along the stems of a species of Dynamena, found just below the line of low-water-mark. The individuals are arranged, in a quincunx manner, on both sides of a long, slender, creeping stem, which does not branch. It resembles a true Campanularia in having a transparent bell disconnected from the stem. Other-

Fig. 190.

Fig. 189. Different attitude of the Medusa of Fig. 184.

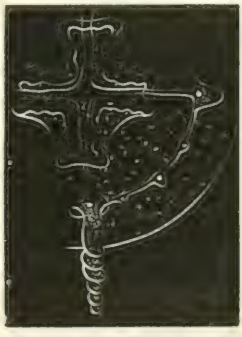
Fig. 190. Hydrarium of Lafœa calcarata; the extremity of the reproductive calycle is somewhat injured. See Fig. 191.

wise the sterile Hydra reminds us of a true Sertularian, with a few thick tentacles, and a long digestive cavity, capable of great expansion. The bell is attached to the stolon by a short stem, a mere bend in its lower portion, so that the sterile individuals are set off a short distance from the main stem. (Fig. 190.) The reproductive calycles are gigantic, compared to the size of the sterile individuals. (Fig. 190.) They are few in number, not more than two or three to a stem, and resemble those of *L. amphora;* only one or two Medusæ are developed simultaneously, the more advanced one filling the cavity of the capsule almost entirely. (Figs. 190, 191.) The sterile individuals recall the Tubularians, as do in fact all the Sertularians, in which the connection between the bell of the sterile individuals and the digestive cavity is not as intimate as in the true Campanularians, giving us at the same time a measure of the embryonic standing of the Tubularians, the Sertularians, and the Campanularians; the Medusæ of this Sertularian-like Hydromedusarium resemble more those of the Tubularians than those of the Campanularians. The vertical diameter of the Medusa is greater than the transverse; the bell is of moderate thickness, the abactinal part being slightly conical (Fig. 192); the digestive cavity is short, and consists of four simple lobes, giving the actinostome the shape of a cross. When it escapes from the reproductive calycle, it has only two long tentacles, two slightly developed

Fig. 191.

Fig. 192.

Fig. 193.



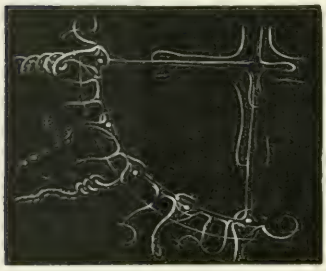
ones, and four more hardly perceptible in the middle of the space between the four chymiferous tubes (Fig. 193); at the base of all the tentacles, and over the whole surface of the digestive cavity, we find large yellow cells scattered irregularly; the long tentacles are highly contractile; a spiral of lasso cells, diminishing in size, and beginning at a small distance from the sensitive bulb, winds round the tentacles;

Fig. 191. Uninjured reproductive calycle.
Fig. 192. Medusa immediately after its escape from the reproductive calycle.
Fig. 193. A Medusa somewhat more advanced, from the abactinal pole.

at the base of the tentacles the walls are thick, and the sensitive swelling quite prominent, having a dark pigment-spot. The Medusa, when it escapes from the reproductive calycle, has a vertical diameter of about one twentieth to one sixteenth of an inch; the Hydromedusarium is from a quarter to an inch long.

In the next stage observed (Fig. 194) we find the rudimentary tentacles of the previous stage fully developed, and at the same time the thread-like cirri of the adult Lafœa. This stage is important, connecting as it does, without any doubt, two Medusæ which had thus far been placed in different genera. The digestive cavity and the ovaries are nearly in the same condition as that observed in young Medusæ, where the spur and the different kinds of marginal appendages were as well developed as in the adult; we have as yet, however, in the present stage (Fig. 194), no trace of the spur or of the club-like appendages of the circular tube found in the adult. These club-like appendages of Lafœa and of Ptychogena show that the marginal capsules, the compound eyes, the cirri, and the different rudimentary appendages, are only modified tentacles.

Fig. 194.



Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 151, Naushon, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 271, Naushon, 1861, A. Agassiz. Medusa.

Cat. No. 438, Naushon, 1864, A. Agassiz. Medusa.

Lafœa cornuta Lamx.

Lafœa cornuta Lamx. Expos. Méthod. 1812.

Newfoundland (Lamouroux).

Lafœa dumosa Sars.

Lafœa dumosa Sars; in Vidensk. Forh. 1862.
Campanularia dumosa Johnst. Brit. Zooph. 1838.

Massachusetts Bay (A. Agassiz). Medusa.

Cat. No. 433, Sea-Coal Bay, N. S., Anticosti Expedition, 1861. Hydrarium.

Fig. 194. Young Medusa still further advanced than Fig. 193.

LAODICEA Less.

Laodicea Less. Zooph. Acal., p. 294. 1843.
Laodicea Agass. Cont. Nat. Hist. U. S., IV. p. 350. 1862.
Cosmetira Forbes. Brit. Naked-eyed Medusæ, p. 42. 1848.
Thaumantias Gegenb. (*non* Esch.); in Zeit. f. W. Zool., p. 237. 1856.

Laodicea cellularia A. Agass.

Laodicea cellularia A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 350. 1862.

I am somewhat doubtful whether this species (Fig. 195) belongs to the genus Laodicea, as the examination of the tentacles could not be made sufficiently accurate to determine this point. The general form

Fig. 195

Fig. 196.

of the ovaries, however, is the same, beginning at the digestive cavity, and running in the form of small hanging lobes along the chymiferous tubes, close to the circular tube. The digestive cavity is so short that the edge, which extends in the shape of four long, narrow lips, deeply frilled (Fig. 196), seems the continuation of the chymiferous tubes, reminding us somewhat of the structure of the actinostome of the Æquoridæ, as in Stomobrachium. The epithelial cells are large, irregular, and hexagonal, and can easily be seen with the naked eye. The color of the spherosome is light violet, the ovaries and digestive cavity being of a darker color, and the base of the circular tentacles of a still stronger shade. There are about twenty-four tentacles between each of the four chymiferous tubes, and a tentacle opposite each tube. Found in the Gulf of Georgia and at Port Townsend, from July to September.

Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 270, Gulf of Georgia, W. T., 1859, A. Agassiz. Medusa.

Fig. 195. Laodicea cellularia.

Fig. 196. One of the lips of the actinostome. *c*, *c*, *c*, *c*, termination of the chymiferous tubes into the digestive cavity, *d* : *l*, fold of the actinostome connecting the lips of the actinostome.

COSMETIRA Forbes.

A remarkable Hydroid Medusa, belonging to the genus Cosmetira of Forbes, was brought home by the Anticosti Expedition.

Magdalen Islands, Gulf of St. Lawrence.

Cat. No. 371, Magdalen Islands, N. S., Anticosti Expedition. Medusa.

Family MELICERTIDÆ Agass.

Melicertidæ Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.

GONIONEMUS A. Agass.

Gonionemus A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 350. 1862.

Gonionemus has a general resemblance to Melicertum, but differs from it by the shape of the ovaries and of the spherosome. The spherosome is an oblate half-spheroid, cut from pole to pole; the ovaries are in lobes alternating on the sides of the chymiferous tubes, and extending their whole length, from the digestive cavity to the circular tube; the digestive cavity is long, and very flexible; the tentacles are numerous, large, and exceedingly contractile; chymiferous tubes four in number.

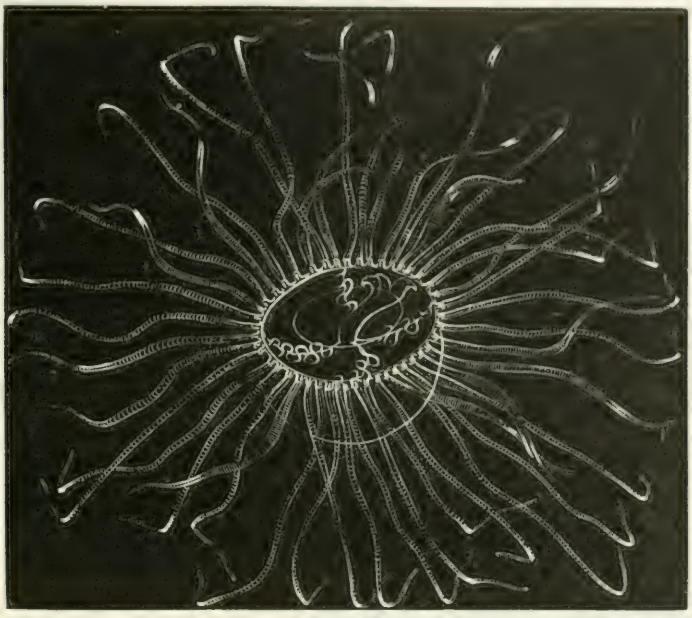
Gonionemus vertens A. Agass.

Gonionemus vertens A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 350. 1862.

This Medusa was quite commonly found during the month of July, swimming in patches of kelp. It at once attracted my attention by its peculiar mode of moving. I could see these Jelly-fishes, with the tentacles spread out to their fullest extent, sinking slowly to the bottom, the disk turned downward; the moment a blade of kelp touches the disk, they stop, bend their tentacles like knees, and remain attached to the sea-weed by means of their lasso cells (Fig. 197), which are arranged in rings scattered thickly over the surface of the tentacles; after remaining attached in this way a moment, with their tentacles extended and mouth turned upwards, they suddenly let go their hold, turn upside down, contract their tentacles (Fig. 198) to a third of their former length, and begin their upward movements by means of short, rapid jerks, given by the sudden expanding and contracting of the tentacles as they are violently thrown out from the cavity covered by the veil. They keep up this rapid motion until they reach the surface of the water; at the instant the upper part of the

disk touches the top of the water, the Medusa inverts itself, and sinks, with its tentacles fully expanded, until it reaches the bottom, or another piece of sea-weed, where it attaches itself, and after remaining suspended a little while, repeats the same operation; when attached, it requires strength enough to break the tentacles to make them loose

Fig. 197.



their hold. I have never found single individuals, but have always seen them in large numbers swimming among the sea-weed in the manner described. The form of the spherosome is that of an oblate spheroid, cut in two by a plane passing through the north and south poles, the plane of intersection containing the circular tube; there are sixty-four tentacles, fifteen between each chymiferous tube, placed so closely together that they seem all to unite at the base. The tentacles, when contracted, resemble a scythe fastened by a band to the circular tube (Fig. 199); the pigment-cells are numerous, and give the circular tube the appearance of having a large row of violet knobs, to which the tentacles are attached. There is one part of the tentacle, near the tip, which seems to be more thickly covered by lasso-cells, and by which the Jelly-fishes attach themselves; when the tentacles are fully expanded, they always make an angle at that point, as if they had been broken, and the parts joined together again. (Fig. 197.) The

Fig. 198.

Fig. 197. Gonionemus vertens, as it appears when attached by its tentacles.
Fig. 198. Gonionemus vertens, in motion; natural size.

ovaries are frill-like lobes (Fig. 200), passing from one side to the other of the chymiferous canal; the chymiferous tubes are slender, and appear like four dark-violet threads, connecting the different lobes of the

Fig. 201.

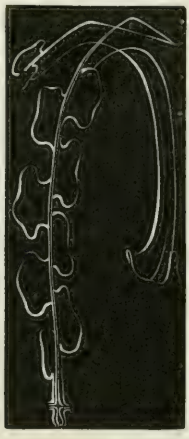


Fig. 200

Fig. 199.

ovaries. (Fig. 201.) The digestive cavity reaches about two thirds of the length of the chymiferous tubes; it is very flexible, but scarcely contractile (Fig. 201), ending in four large lobes, capable of extending far beyond the main wall of the digestive cavity; the veil is large, leaving an opening of half the diameter across the circular tube.

Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 286, Gulf of Georgia, W. T., 1859, A. Agassiz.

MELICERTUM Oken.

Melicertum Oken. Lehrb. der Naturg. 1816.
Melicertum Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.
Melicerta Pér. et Les. (*p. p.*); in Ann. du Mus., XIV. p. 40. 1809.
Campanella Less. (*non* Bl.). Zooph. Acal., p. 281. 1843.
Stomobrachium Forbes (*non* Br.). Naked-eyed Medusæ, p. 30. 1848.

Melicertum campanula Esch.

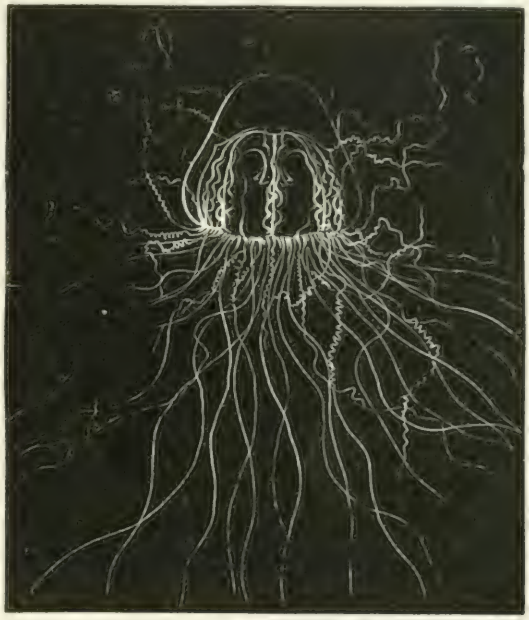
Melicertum campanula Esch. Syst. der Acal., p. 105. 1829.
Melicertum campanula Agass. Cont. Nat. Hist. U. S., IV. p. 349. 1862.
Melicertum campanula A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 96, Figs. 18, 19.
Melicerta campanula Pér. et Les.; in Ann. du Mus., p. 40. 1809.
Medusa campanula Fab. Fauna Grönlandica. 1780. No. 360.
Medusa campanulata Bosc. Hist. Nat. d. Vers., II. p. 170.
Campanella Fabricii Less. Zooph. Acal., p. 281. 1843.
Campanella campanula Mörch; in Beskriv. af Grönland, p. 95. 1857.

This Medusa, first mentioned by Fabricius, has, like many others so characteristically described by him, escaped notice entirely, till it was

Fig. 199. The bend of a contracted tentacle.
Fig. 200. A portion of the genital organs.
Fig. 201. One chymiferous tube and half of the digestive cavity.

observed on the coast of New England. Undoubtedly a few others of the Jelly-fishes he has enumerated will prove identical with species since described, on the coast of England and on our own shores. A Medusa of this same genus was figured and described by Forbes under the name of *Stomobrachium octocostatum;* from the figure of Forbes it is evidently not a Stomobrachium, and is probably this same Medusa which he found in the North of Scotland. Fig. 202 is a profile view, natural size, of the Melicertum, one of the most common of our naked-eyed Medusæ. In the fall, at the time of spawning, it literally swarms at the surface, and on sunny days seems particularly to delight to come to the surface, where it remains in the afternoon until dark, being one of the few Medusæ (*Zygodactyla groenlandica* has the same habit) which are to be met with in the afternoon. The genus Melicertum is closely related to the Æquoridæ, by the number of its radiating tubes (of which there are eight), and to Staurophora, by the blending of the genital organs with the actinostome, and the total absence of marginal bodies, such as capsules, cirri, and so forth. If the small Medusæ here figured (Figs. 203, 204) are in reality the young of Melicertum, — Melicertum being the only Medusa allied to Staurophora which has no eye-specks, — the close affinity between them is still more strongly marked in the young of these two genera, which can only be distinguished from one another by the presence or absence of eye-specks.

Fig. 202.



From an examination of the Medusa of *Lafœa calcarata,* I had already come to the conclusion that the young Medusa was nearly related to Staurophora and Melicertum. Having succeeded in finding another Medusa evidently closely allied to it, I was not surprised in recognizing a Melicertum of younger stage than any which I had observed before. With the stage represented in Fig. 205, which has been traced until there could be no doubt as to the genus to which the young Medusa belonged, I was sufficiently familiar, from its frequent occurrence in the latter part of the spring, to recognize at once in

Fig. 202. Profile of Melicertum campanula, natural size.

Fig. 203 only a somewhat younger form of the same Medusa. We have thus established, by the observation of this Medusa, as well as from the young Hydrarium of Melicertum and Lafœa, the probable character of the Hydrarium from which Melicertum, Staurophora, and those Medusæ which have no marginal capsules, are developed; showing that they hold an intermediate position between the Campanularians and the Tubularians, being more closely allied to the latter in their embryonic condition, and assuming as adult Medusæ somewhat the aspect of Campanularian Medusæ. The *Trichydra pudica* of Wright is also closely allied to Lafœa and Staurophora. In the young Medusa we have at first only two primary tentacles (Fig. 204) and two rudimentary ones, and in the next stage there are sixteen. (Fig. 205.)

Fig. 203

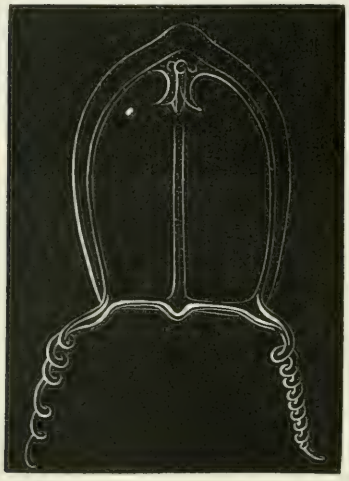
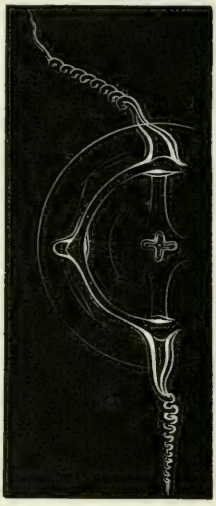


Fig. 204.



The presence of eye-specks at the base of the tentacles of the young Medusæ of *Lafœa calcarata* and of *Staurophora laciniata* are the surest means of distinguishing them with accuracy. The differences in the shape of the bell between these youngest Medusæ (Fig. 203) and somewhat older stages (Fig. 205), are of a similar character to those we are familiar with among the young Campanularian Medusæ of other genera. To judge from analogy, I strongly suspect that the young Medusa of Staurophora will in its turn be a Medusa, similar to these Lafœan forms, having at first but two primary tentacles. In the next

Fig. 205.

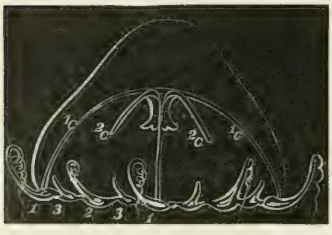


Fig. 203. Profile view of very young Medusa of Melicertum campanula; Lafœan like. See Fig. 192.

Fig. 204. Half the disk of the same, seen from the actinal pole.

Fig. 205. Young Melicertum, with only four completely formed chymiferous tubes. 1c, first set of chymiferous tubes; 2c, second set; 1, 2, 3, tentacles of the first, second, and third sets.

stage (Fig. 205), which is undoubtedly a young Melicertum, we find the second set of four chymiferous tubes developing (2_c, Fig. 205); they arise, as in the Æquoridæ, from the digestive cavity, and extend towards the circular tube; there are at this stage sixteen tentacles, usually carried curled up, as in the accompanying figure. I have not seen the young Melicertum in stages intermediate between those slightly more advanced than Fig. 205, and when they are fully developed, as in Fig. 202, where the genital organs extend to the circular tube, and the marginal tentacles have become exceedingly numerous.

Fig. 206.

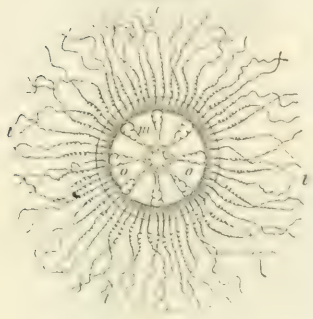


Fig. 207.

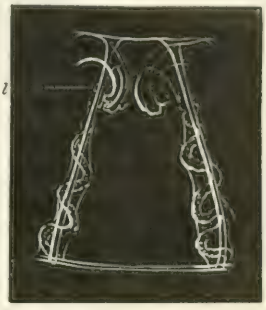
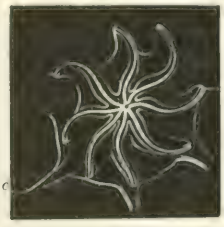


Fig. 208.



The spherosome is regularly bell-shaped; it is capable of very varied expansion and contraction, appearing at some times almost rectangular, then as if tied in the middle, swelling at both poles, again flaring at the abactinal extremity, and strongly contracted at the circular tube, or flattened like a quoit. The tentacles may expand several times the polar diameter of the bell, or contract, by curling close to the circular tube. The bell is of a light ochre color; the genital organs, as well as the base of the tentacles, are of a darker shade. When seen from above (as Fig. 206), the radiating tubes open into a sort of cavity, as in the Æquoridæ, the folds of one genital organ extending across to the next, as seen in Figs. 207, 208; the ovaries are convoluted (Fig. 207), extending from *l*, Fig. 207, to the circular tube, where they have their greatest diameter; the lips of the actinostome are carried in eight folds (Fig. 208), each one, *l*, corresponding to one of the radiating tubes, *c*, as in the Æquoridæ; the lips project but little into the cavity of the bell. The tentacles are hollow, somewhat dumb-bell shaped at the base

Fig. 209.

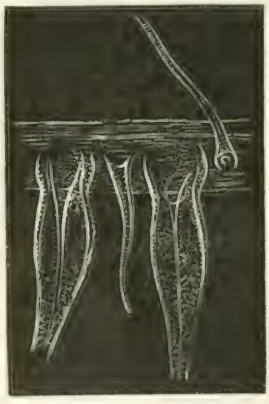


Fig. 206. The same, seen from the abactinal pole. *m*, mouth; *o*, genital organs; *t*, tentacles.
Fig. 207. Magnified view of two chymiferous tubes and genital glands. *l*, lips of actinostome.
Fig. 208. Mode of carrying the lips of the actinostome. *l*, lips of actinostome; *c*, chymiferous tube.
Fig. 209. Magnified view of marginal tentacles.

(Fig. 209), and taper rapidly; they are thickly covered with lasso-cells.

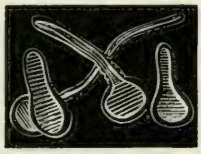
Artificial fecundation of these Medusæ can be very readily made by keeping males and females for a day or two together in a glass jar, when we shall find, swimming near the bottom, innumerable spherical embryos (Fig. 210), in which the spheres of segmentation are still

Fig. 210

Fig. 211.

Fig. 212.

Fig. 213.



visible; these elongate (Fig. 211), a cavity is formed at the blunt end, and we have a somewhat pear-shaped embryo, strongly ciliated, with walls of uniform thickness (Fig. 212), swimming about with great velocity; these embryos attach themselves by the blunt end (Fig. 213), and soon elongate, as in the two middle figures of Fig. 213; the slender extremity next swells (Fig. 214), and this is the first trace of the sterile Hydra head. The wall of this swelling soon becomes somewhat indented, as in Fig. 214, where we have some of the successive stages of the sterile Hydra, until it forms a small horny bell, covering only the base of the long, sterile Hydra head, which terminates with ten stout, short tentacles, connected by a web. This Hydrarium differs considerably from that of Lafœa, but it still has sufficient resemblance to show their connection; it is one of the easiest to raise, the Planulæ are very hardy, and the development of the Hydrarium is readily followed. It grows in small tufts, which after six months had not attained a greater height than one third of an inch.

Fig. 214.

Greenland (Fabricius); Massachusetts Bay (Agassiz).

Cat. No. 351, Grand Manan, L. Agassiz. Medusa.

Cat. No. 373, Nahant, 1863, A. Agassiz. Medusa.

Cat. No. 448, Nahant, 1864, A. Agassiz. Medusa.

Fig. 210. Spherical embryo.

Fig. 211. The same, somewhat more advanced.

Fig. 212. The same, immediately before becoming attached.

Fig. 213. Group of embryos attached, in different stages of development.

Fig. 214. Different stages of growth, beyond those of Fig. 213, till the sterile Hydra is fully developed.

Melicertum georgicum A. Agass.

Melicertum georgicum A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 349. 1862.

The Medusa (Fig. 215) is here figured to show the differences noticed between it and the New England representative of the genus. The pointed spherosome, the smaller number of the circular tentacles, the longer actinostome, and the termination of the genital organs, somewhat above the circular tube, are characters which readily distinguish the *M. georgicum* from its Eastern representative. The knowledge of its complete development will settle this point definitely. The close resemblance of the mode of attachment of the ovaries to that of the Æquoridæ, referred to in the preceding species, is readily seen

Fig. 215.

Fig. 216.

in Fig. 216. The genital folds are looped up on the upper side of the interior of the bell in an octagonal outline (Fig. 216), opening into the large cavity formed by the eight constrictions of the lips, *l*, of the actinostome. The difference is simply in the number of the chymiferous tubes, as well as in the mode of carrying the lips of the actinostome. A simple flattening of the spherosome, and an increase in the number of chymiferous tubes, would give us an Æquorea. This Medusa is found, in the summer, in the Gulf of Georgia, W. T.

Fig. 215. Profile of Melicertum georgicum, natural size.

Fig. 216. Digestive cavity and point of junction of the chymiferous tubes. *l*, lips of actinostome; *p*, abactinal point of attachment of genital organs; *c*, opening leading into chymiferous tubes. Magnified.

STAUROPHORA Brandt.

Staurophora Brandt (*non* Forbes); in Mém. Acad. St. Petersburg, II. p. 399. 1835.
Staurophora Agass.; in Mem. Am. Acad., IV. p. 300.
Staurophora Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1862.
Staurophora Less. Zooph. Acal., p. 297. 1843.

Staurophora laciniata Agass.

Staurophora laciniata Agass.; in Mem. Am. Acad., IV. p. 300, Pl. 7. 1849.
Staurophora laciniata Agass. Cont. Nat. Hist. U. S., IV. p. 351. 1862.
Staurophora laciniata A. Agass.; in Proc. Boston Soc. Nat. Hist., IX. Figs. 1, 2, 3.
Staurophora laciniata Stimps. Mar. Inv. Grand Manan, p. 11. 1853.

The youngest Medusa of Staurophora which has been observed (Fig. 215ª) resembles to such an extent the young Melicertum (Figs. 203, 205), as readily to have been taken for different stages of the same Jelly-fish, did not the absence of pigment eye-specks enable me to distinguish them sufficiently easily. The development of the tentacles of the young Medusa explains itself from the accompanying figures (Figs. 216ª, 217), as well as the changes of form of the digestive cavity, as it passes from a simple pendent pouch (Fig. 215ª) through the different stages (*a*, *b*, *c*, Fig. 218), where the digestive cavity loses little by little its individuality, the corners gradually extend along the chymiferous tubes, and in

Fig. 215ª.

Fig. 216ª.

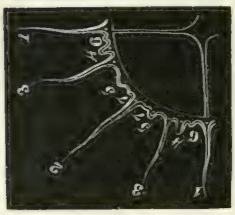


Fig. 217

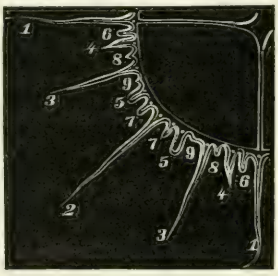


Fig. 218.

quite young specimens (*c*, Fig. 218) the actinostome can no longer be distinguished among the innumerable small folds of the genital pouches. In Fig. 219 the young Staurophora has all the characters of the adult, excepting the size of the different parts. The violet pigment-spots at the base of the tentacles are quite apparent, being perceptible in

Fig. 215ª. Young Staurophora, with eight tentacles.
Fig. 216ª. Quarter of the disk of a young Staurophora, with sixteen large tentacles.
Fig. 217. Young Medusa, somewhat more advanced than Fig. 216ª.
Fig. 218. Different stages of the actinostome, intermediate between that of Figs. 215ª and 219. *a*, the youngest; *b*, the next; *c*, the oldest.

younger stages. (Figs. 215ª, 216ª, 217.) This Medusa grows to a large size, measuring often six to eight inches in diameter. It is one of the earliest Medusæ to make its appearance, attains its full size rapidly from May to June, and by the end of June the dead Medusæ are found in large numbers, floating about after storms; by the middle of July they have all disappeared. Found at Nahant.

Fig. 219.

Massachusetts Bay (Agassiz); Maine (Stimpson).

Cat. No. 275, Nahant, A. Agassiz. Young and old Medusæ.

Cat. No. 359, Boston Harbor, L. Agassiz. Medusa.

Staurophora Mertensii Br.

Staurophora Mertensii Br.; in Mém. Acad. St. Petersb., IV. p. 400, Pls. 24, 25. 1838.
Staurophora Mertensii Less. Zooph. Acal., p. 297. 1843.

Norfolk Sound (Mertens).

PTYCHOGENA A. Agass.

The Medusa for which this genus has been established shows the intimate structural connection between Staurophora, Melicertum, and Polyorchis. The structure of the genital organs is an intermediate state of development between organs where the folds of the actinostome are lost in the genital folds, as in Staurophora, and the other extreme, where we have pendent genital organs attached to one extremity of diverticulate chymiferous tubes, as in Polyorchis.

Ptychogena lactea A. Agass.

The bell of this Medusa is rather high (Fig. 220), and the spherosome of considerable thickness, giving this species an appearance of consistency, which is heightened by the striking contrast with the water of the milky genital organs and numerous marginal tentacles. The chymiferous tubes are broad; at an equal distance on the abactinal and actinal ends, the edges of the tube become hacked; the notches increase in size, and soon become long, sharp folds of the walls of the chymiferous tubes, projecting at right angles from the tubes (Fig. 221); the larger of these folds branch again. To these folds the genital organs are attached, forming as many connecting

Fig. 219. Young Staurophora, having the general aspect of the adult.

pouches as there are points to the projections of the chymiferous tubes; the folds become smaller and smaller (Fig. 222) towards the abactinal pole, and are connected by a loose fold with the actinostome. The opening of the actinostome is large; its folds are small, and do

Fig. 220.

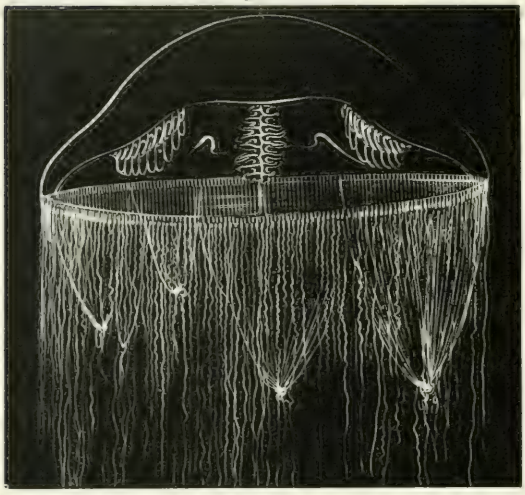
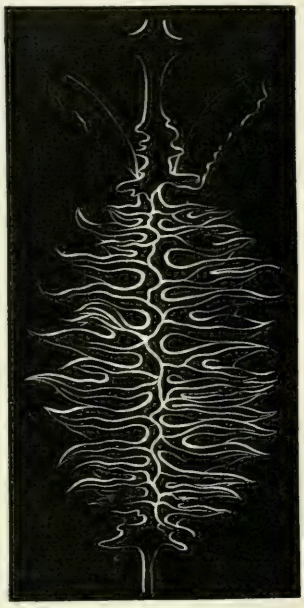


Fig. 221.



not form regular lips, but merely an irregular quadrangular frill. (Fig. 223.) The tentacles are extremely numerous, opening into a large circular tube; they are very much flattened in one direction (*f*, Fig. 224); between every two tentacles is found a club-shaped appendage, made

Fig. 222.

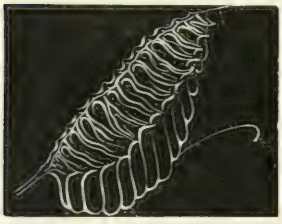


Fig. 223.

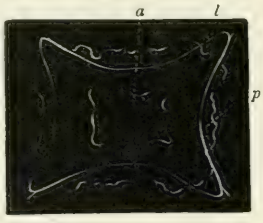
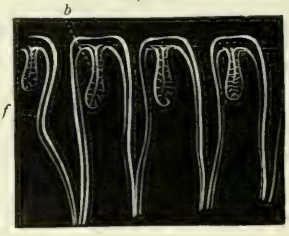


Fig. 224.



up of large cells somewhat like those of *Lafœa calcarata* (*b*, Fig. 224); the tentacles are capable of great expansion, and when contracted are usually curled up tightly, as is the case in Melicertum and Staurophora; they are very frequently tied up in festoons, as in Fig. 220. This

Fig. 220. Profile view of Ptychogena, somewhat reduced.

Fig. 221. Magnified view of the genital organs, seen from the abactinal pole.

Fig. 222. The same as Fig. 221, seen in profile, on a somewhat smaller scale.

Fig. 223. Actinostome. *a*, opening of actinostome; *p*, point of attachment of the digestive cavity; *l*, lips of the actinostome.

Fig. 224. Magnified base of tentacles and club-shaped appendages. *f*, swelling of tentacles; *b*, club-shaped appendages.

Medusa, like Tima, swims at a considerable depth below the surface. The action of the light and increase of temperature of the surface is sufficient to kill them in the course of half an hour; the moment they are brought to the surface, the spherosome loses its transparency, the genital organs become dull, and the Medusa is soon completely decomposed. This action is much more rapid than any thing of the kind which I have noticed even in Ctenophoræ, Mertensia being the only genus in which the decomposing effects of light and heat are at all equal to what is produced here. This Jelly-fish must be a deep-water species, as they have only been found during a single fall, and then only for a few days, when they seemed quite abundant.

Massachusetts Bay, Nahant (A. Agassiz).

Family PLUMULARIDÆ Agass.

Plumularidæ Agass. Cont. Nat. Hist. U. S., IV. p. 358. 1862.
Sertularidæ Johnst. (*p. p.*). Brit. Zooph., p. 89.

AGLAOPHENIA Lamx. (*restr.* McCr.).

Aglaophenia Lamx. (*pars*); in Bull. Soc. Phil. 1812.
Aglaophenia McCr. Gymnoph. Charleston Harbor, p. 98. 1857.
Aglaophenia Agass. Cont. Nat. Hist. U. S., IV. p. 358. 1862.
Plumularia Lamk. (*pars*). Anim. s. Vert., II. p. 159.

Aglaophenia pelasgica McCr.

Aglaophenia pelasgica McCr. Gymn. of Charleston Harbor, p. 99. 1857.
Sertularia pelasgica Bosc. Hist. Nat. Vers., III. p. 122.
Plumularia pelasgica Lamk. An. s. Vert., II. p. 167.
Dynamena pelasgica Blainv. Man. d'Actin., p. 484.

Cat. No. 253, Florida, 1858, L. Agassiz. Hydrarium.

Cat. No. 254, Tortugas, Fla, 1859, L. Agassiz. Hydrarium.

Cat. No. 255, Hayti, 1858, Dr. D. F. Weinland. Hydrarium.

Cat. No. 256, Gulf Weed, 1858, Dr. D. F. Weinland. Hydrarium.

Cat. No. 257, Gulf Weed, 1858, Dr. D. F. Weinland. Hydrarium.

Cat. No. 390, a hundred miles south of Cape Hatteras, A. S. Bickmore. Hydrarium.

Cat. No. 391, a hundred miles south of Cape Hatteras, A. S. Bickmore. Hydrarium.

Aglaophenia trifida Agass.

Aglaophenia trifida Agass. Cont. Nat. Hist. U. S., IV. p. 358. 1862.
Aglaophenia cristata McCr. (*non* Lamk.). Gymn. Charl. Harb., p. 100.

Charleston, S. C. (L. Agassiz).
Cat. No. 252, Charleston, S. C., Jan. 1852, L. Agassiz. Hydrarium.

Aglaophenia tricuspis McCr.

Aglaophenia tricuspis McCr. Gymn. Charleston Harbor, p. 101.

Charleston, S. C. (McCrady).

Aglaophenia franciscana A. Agass.

Plumularia franciscana Trask; in Proc. Cal. Acad., March, 1857, p. 101, Pl. 4, Fig. 3.
Plumularia struthionides Murr.; in Ann. & Mag. N. H., V. p. 251. 1860.

San Francisco (A. Agassiz).
Cat. No. 259, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.
Cat. No. 260, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.

PLUMULARIA Lamk. (*restr.* McCr.).

Plumularia Lamk. (*p. p.*) An. s. Vert., II. p. 159.
Plumularia McCr. Gymn. Charleston Harbor. 1857.
Plumularia Agass. Cont. Nat. Hist. U. S., IV. p. 358. 1862.

Plumularia quadridens McCr.

Plumularia quadridens McCr. Gymn. Charleston Harbor, p. 97.
Plumularia quadridens Agass. Cont. Nat. Hist. U. S., IV. p. 358. 1862.

Charleston, S. C. (McCrady); Florida (L. Agassiz).
Cat. No. 251, Ship Channel, Florida, January, 1856, L. Agassiz.

Plumularia arborea Des.

Plumularia arborea Des.; in Proc. Bost. Soc. Nat. Hist., III. p. 65. 1848.

Massachusetts Bay (Desor).

Family SERTULARIADÆ Johnst.

Sertulariadæ Johnst. British Zoophytes, p. 57.

DYNAMENA Lamx. (*restr.* Agass.).

Dynamena Lamx.; in Bull. Soc. Phil. 1812.
Dynamena Agass. Cont. Nat. Hist. U. S., IV. p. 355. 1862.

Dynamena pumila Lamx.

Dynamena pumila Lamx. Cor. Flex., p. 179.
Dynamena pumila Johnst. Brit. Zooph., p. 66.
Dynamena pumila Agass. Cont. Nat. Hist. U. S., IV. pp. 326, 355, Pl. 32. 1862.
Dynamena pumila Pack.; in Can. Nat. & Geol., Dec. 1863.
Sertularia pumila Mörch; in Beskriv. af Greenland, p. 97. 1857.
Sertularia thuja Fab. (*teste* Mörch). Fauna Groenl., No. 456.

This is one of the few of our Hydroids (Fig. 225) which have been compared in a living state with European specimens sent by Mr. Thos. J. Moore to the Museum, and brought across the Atlantic by Captain Anderson. Professor Agassiz, supposing it to be a distinct species, had previously given it the name of *Dynamena Fabricii;* and before he

Fig. 225.

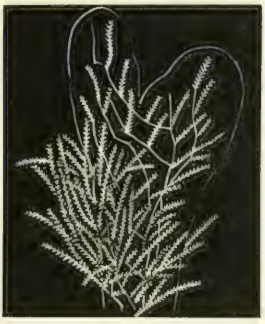
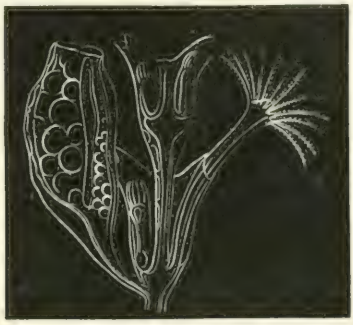


Fig. 226.



had examined the development of the sessile Medusa (Fig. 226), supposed it to be the Hydroid of our *Melicertum campanula.* See, for the Hydroid of Melicertum, the description of that species.

European and American shores of Atlantic Ocean (Ellis, Agassiz).
Cat. No. 163, New Brighton, England, 1860, H. J. Clark. Hydrarium.
Cat. No. 164, Liverpool, October, 1861, Thos. J. Moore. Hydromed.
Cat. No. 165, Lynn, Mass., May, 1852, H. J. Clark. Hydromedusarium.
Cat. No. 166, Nahant, July, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 167, Nahant, May, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 168, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Fig. 225. Cluster of Dynamena pumila.
Fig. 226. Magnified portion of stem of Fig. 225.

Cat. No. 169, Nahant, June, 1855, H. J. Clark. Hydromedusarium.
Cat. No. 170, Nahant, September, 1854, H. J. Clark. Hydrarium.
Cat. No. 171, Chelsea Beach, L. Agassiz. Hydrarium.
Cat. No. 172, Cohasset, Mass., L. Agassiz. Hydrarium.
Cat. No. 173, Nantucket, Mass., August, 1857, L. Agassiz. Hydromedusarium.
Cat. No. 174, Grand Manan, August, 1857, J. E. Mills. Hydromedusarium.
Museum Diagram No. 18, after L. Agassiz.

Dynamena cornicina McCr.

Dynamena cornicina McCr. Gymn. Charl. Harb., p. 102.

Charleston, S. C. (L. Agassiz).
Cat. No. 175, Charleston, S. C., L. Agassiz. Hydrarium.
Cat. No. 176, Charleston, S. C., 1852, L. Agassiz. Hydrarium.

DIPHASIA Agass.

Diphasia Agass. Cont. Nat. Hist. U. S., IV. p. 355. 1862.

Diphasia fallax Agass.

Diphasia fallax Agass. Cont. Nat. Hist. U. S., IV. p. 355. 1862.
Sertularia fallax Johnst. Brit. Zooph., p. 73, Pl. 11, Figs. 2, 5, 6.
Sertularia fallax Stimps. Mar. Inv. Grand Manan, p. 9. 1853.

Grand Manan (W. Stimpson); Massachusetts Bay.
Cat. No. 183, Eastport, Me., 1851, L. Agassiz.
Cat. No. 184, Eastport, Me., 1852, W. Stimpson.
Cat. No. 185, Massachusetts Bay, L. Agassiz.
Cat. No. 427, Eastport, Me., 1861, Anticosti Expedition.
Cat. No. 428, Eastport, Me., 1863, A. E. Verrill.

Diphasia rosacea Agass.

Diphasia rosacea Agass. Cont. Nat. Hist. U. S., IV. p. 355. 1862.
Sertularia rosacea Linn. Syst. 1306.
Sertularia rosacea Johnst. Brit. Zooph., p. 64.
Sertularia rosacea Pack.; in Can. Nat. & Geol., Dec. 1863.
? Sertularia plumea Des.; in Proc. Bost. Soc. N. H., III. p. 66. 1848.

Nahant, Suisconset, Mass. (A. and L. Agassiz).
Cat. No. 180, New Brighton, England, Oct. 1860, H. J. Clark. Hydromedusarium.
Cat. No. 181, Nahant, Mass., July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 182, Suisconset, Mass., July, 1849, L. Agassiz. Hydromedusarium.

Diphasia corniculata A. Agass.

Sertularia corniculata Murray; in Ann. & Mag. N. H., X. Pl. XI. Fig. 3. 1860.

Bay of San Francisco (Murray).

SERTULARIA Linn. (*emend.* Agass.).

Sertularia Linn. Syst. Nat.
Sertularia Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

Sertularia abietina Linn.

Sertularia abietina Linn. Syst. 1307.
Sertularia abietina Fab. Fauna Groenlandica. No. 453.
Sertularia abietina Johnst. Brit. Zooph., p. 75.
Sertularia abietina Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

St. George's Bank, Newfoundland; Mingan Islands.
Cat. No. 195, New Brighton, Eng., Oct. 1860, H. J. Clark. Hydrarium.
Cat. No. 196, Liverpool, Eng., 1861, Thos. J. Moore.
Cat. No. 197, St. George's Bank, W. Stimpson.
Cat. No. 419, Mingan Islands, 1861, Anticosti Expedition.

Sertularia cupressina Linn.

Sertularia cupressina Linn. Syst. 1308.
Sertularia cupressina Johnst. Brit. Zooph., p. 80.
Sertularia cupressina Leidy. Inv. R. I. and N. J., p. 6.
Sertularia cupressina Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

Absecom Beach (Leidy); Massachusetts Bay (Agassiz).
Cat. No. 202, New Brighton, Eng., October, 1860, H. J. Clark. Hydromedusarium.
Cat. No. 203, Beverly, July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 204, Nahant, May, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 205, Chelsea, May, 1862, H. J. Clark. Hydromedusarium.
Cat. No. 206, Eastport, Me., 1851, W. Stimpson. Hydromedusarium.
Cat. No. 207, Mount Desert, Me., W. Stimpson. Hydromedusarium.
Cat. No. 208, Suisconset, July, 1849, L. Agassiz. Hydromedusarium.
Cat. No. 209, Suisconset, Mass., L. Agassiz. Hydrarium.
Cat. No. 211, Lynn, Mass., Jan. 1861, H. J. Clark. Hydrarium.
Cat. No. 212, Massachusetts Bay, L. Agassiz.

Sertularia argentea Ell. & Sol.

Sertularia argentea Ellis & Sol. Zooph., p. 38.
Sertularia argentea Johnst. Brit. Zooph., p. 79, Pl. 15, Fig. 3; Pl. 14, Fig. 3.
Sertularia argentea Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.
Sertularia argentea Stimps. Mar. Inv. Grand Manan, p. 8. 1853.
Sertularia argentea Mörch.; in Besk. af Grönland, p. 97.
Sertularia fastigiata Fab. (*teste* Mörch). Fauna Grönlandica, No. 458.

Grand Manan (W. Stimpson).
Cat. No. 213, New Brighton, Oct. 1860, H. J. Clark. Hydrarium.

Sertularia falcata Linn.

Sertularia falcata Linn. Syst. 1309.
Sertularia falcata Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.
Plumularia falcata Johnst. Brit. Zooph., p. 90, Pl. 21, Figs. 1, 2.
Plumularia falcata Pack.; in Can. Nat. & Zool. Dec. 1863.
Plumularia falcata Stimps. Mar. Inv. Grand Manan, p. 8. 1853.
Sertularia tenerissima Stimps. Mar. Inv. Grand Manan, p. 8. 1853.

Grand Manan (W. Stimpson); Eastport, Me. (W. Stimpson); Mingan Islands; Massachusetts Bay (Agassiz).
Cat. No. 218, New Brighton, Eng., 1860, H. J. Clark. Hydrarium.
Cat. No. 219, Grand Manan.
Cat. No. 220, Eastport, Me., 1853, W. Stimpson. Hydromedusarium.
Cat. No. 221, Grand Manan, W. Stimpson.
Cat. No. 222, Eastport, Me., 1851. Hydrarium.
Cat. No. 223, Suisconset, Mass., L. Agassiz. Hydrarium.
Cat. No. 224 (*P. tenerissima*), Grand Manan, W. Stimpson. Hydromedusarium.
Cat. No. 415, Mingan Islands, 1861, Anticosti Expedition. Hydrarium.
Cat. No. 416, Eastport, Me., 1861, A. E. Verrill. Hydrarium.
Cat. No. 417, Mingan Islands, 1861, Anticosti Expedition. Hydrarium.
Cat. No. 424, Eastport, Me., 1861, Anticosti Expedition.

Sertularia anguina Trask.

Sertularia anguina Trask; in Proc. Cal. Acad. N. S., p. 100, Pl. 5, Fig. 1, 1857.
Sertularia labrata Murray; in Ann. & Mag. N. H., V. p. 250, Pl. XI. Fig. 2. 1860.

Bay of San Francisco (Trask, Murray); Monterey, Punta de los Reyes, Tomales Point (Trask).

Sertularia gracilis A. Agass.

Plumularia gracilis Murray; in Ann. & Mag. N. H., V. p. 251, Pl. XII. Fig. 1. 1860.

Bay of San Francisco (Murray).

Sertularia myriophyllum Linn.

Sertularia myriophyllum Linn. Syst. 1309.
Plumularia myriophyllum Johnst. Brit. Zooph., p. 99.

Cat. No. 214, Massachusetts Bay, L. Agassiz.
Cat. No. 418, Mingan Islands, Anticosti Expedition.
Cat. No. 429, Eastport, Me., A. E. Verrill.
Cat. No. 430, Eastport, Me., A. E. Verrill.

Sertularia latiuscula Stimps.

Sertularia latiuscula Stimps. Mar. Inv. Grand Manan, p. 8. 1853.

Grand Manan (W. Stimpson).

Sertularia filicula Ell. & Sol.

Sertularia filicula Ellis & Sol. Zooph., p. 57, Pl. 6, Figs. c, C.
Sertularia filicula Stimps. Mar. Inv. Grand Manan, p. 8. 1853.
Sertularia filicula Johnst. Brit. Zooph., p. 76, Pl. 14, Fig. 1.

Grand Manan (W. Stimpson).

Sertularia furcata Trask.

Sertularia furcata Trask; in Proc. Cal. Acad., March, 1857, p. 101, Pl. V. Fig. 2.

San Francisco (Trask).

Sertularia turgida Trask.

Sertularia turgida Trask; in Proc. Cal. Acad., March, 1857, p. 101, Pl. IV. Fig. 1.

San Francisco (Trask).

Sertularia producta Stimps.

Sertularia producta Stimps. Mar. Inv. Grand Manan, p. 8. 1853.

Grand Manan (W. Stimpson).

AMPHITROCHA Agass.

Amphitrocha Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

Amphitrocha rugosa Agass.

Amphitrocha rugosa Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.
Sertularia rugosa Linn. Syst. 1308.
Sertularia rugosa Fab. Fauna Grönlandica. No. 454.
Sertularia rugosa Johnst. Brit. Zooph., p. 63, Pl. X. Figs. 4–6.
Sertularia rugosa Stimps. Mar. Inv. Grand Manan, p. 9. 1853.
Sertularia rugosa Mörch; in Besk. af Grönland, p. 97.
Amphitrocha cincta Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

Massachusetts Bay (L. Agassiz); Grand Manan (W. Stimpson).
Cat. No. 226, Nahant, April, 1855, H. J. Clark. Hydromedusarium.
Cat. No. 227, Nahant, May, 1855, H. J. Clark. Hydromedusarium.
Cat. No. 228, Nahant, August, 1854, H. J. Clark. Hydrarium.
Cat. No. 229, Nahant, July, 1861; A. Agassiz. Hydrarium.
Cat. No. 230, Nahant, September, 1854, H. J. Clark. Hydrarium.
Cat. No. 406, Nahant, July, 1862, A. Agassiz.

COTULINA Agass.

Cotulina Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.

Cotulina tricuspidata A. Agass.

Sertularia tricuspidata Alder (*non* Murray). Cat. Zooph. Northumb. and Durham, p. 21, Pl. II. Figs. 1, 2. 1857.
Sertularia tricuspidata Pack.; in Can. Nat. & Geol. Dec. 1863.

Massachusetts Bay (L. Agassiz).
Cat. No. 233, Massachusetts Bay, L. Agassiz.
Cat. No. 234, Massachusetts Bay, L. Agassiz.
Cat. No. 235, Eastport, Me., July, 1851, W. Stimpson.
Cat. No. 236, Eastport, Me., July, 1852, W. Stimpson.

Cotulina polyzonias Agass.

Cotulina polyzonias Agass. Cont. Nat. Hist. U. S., IV. p. 356. 1862.
Sertularia polyzonias Linn. Syst. 813.
Sertularia polyzonias Johnst. Brit. Zooph., p. 61, Pl. X. Figs. 1–3.
Sertularia polyzonias Mörch; in Besk. af Grönland, p 97. 1857.
Sertularia polyzonias Stimps. Mar. Inv. Grand Manan, p. 9. 1853.
Sertularia polyzonias Pack.; in Can. Nat. & Geol. Dec. 1863.
Sertularia pinnata Gould. Rep. Inv. Mass., p. 350.

Eastport, Me. (A. E. Verrill); Mingan Islands (Anticosti Expedition); Grand Manan (W. Stimpson).

Cat. No. 426, Eastport, Me., 1863, A. E. Verrill.
Cat. No. 434, Mingan Islands, 1861, Anticosti Expedition.

Cotulina tamarisca A. Agass.

Sertularia tamarisca Linn. Syst. 1307.
Sertularia tamarisca Johnst. Brit. Zooph., p. 74, Pl. XIII. Figs. 2–4.

Eastport, Me. (A. E. Verrill; Sea-Coal Bay, N. S. (Anticosti Expedition); Massachusetts Bay (Agassiz).
Cat. No. 231, Grand Manan, W. Stimpson. Hydrarium.
Cat. No. 232, Massachusetts Bay, W. Stimpson. Hydrarium.
Cat. No. 425, Eastport, Me., 1863, A. E. Verrill.
Cat. No. 431, Sea-Coal Bay, N. S., 1861, Anticosti Expedition.

Cotulina Greenei A. Agass.

Sertularia tricuspidata Murray (*non* Alder). Ann. & Mag., V. p. 200. 1860.
Sertularia Greenei Murray. Ann. & Mag., V. p. 504. 1860.

Growing in very thick clusters, resembling somewhat in their appearance fine brushes of *Dynamena pumila*. It is supported by a very slender stem, which branches near the base; the branches rise vertically, forming fan-shaped tufts, in which all the stems reach one level; there is no prominent main stem. It attains a height of from two to three inches. The secondary branches arise in a similar way, near the base of the primary branches. The sterile hydræ have two prominent exterior points to support the operculum, and two smaller ones near the stem. The reproductive calycles are conical and slightly corrugated, attached by the apex, and terminate in a bottle-shaped neck.
San Francisco, Cal.
Cat. No. 436, San Francisco, Cal., Normal School, Salem.

HALECIUM Oken.

Halecium Oken. Lehrb. der Naturg. 1815.
Thoa Lamx. Pol. Cor. Flex. 1816.
Halecium Agass. Cont. Nat. Hist. U. S., IV. p. 357. 1862.

Halecium muricatum Johnst.

Halecium muricatum Johnst. Brit. Zooph., p. 40, Pl. IX. Figs. 3, 4.
Sertularia muricata Ellis & Sol. Zooph., p. 59, Pl. VII. Figs. 3, 4.

Cat. No. 421, Eastport, Me., 1863, A. E. Verrill.

Halecium halecinum Johnst.

Halecium halecinum Johnst. Brit. Zooph., p. 38, Pl. VIII.
Halecium halecinum Agass. Cont. Nat. Hist. U. S., IV. p. 357. 1863.
Halecium halecinum Mörch; in Beskriv. af Grönland, p. 97. 1857.
Sertularia halecina Linn. Syst. 1308.
Sertularia halecina Fab. Fauna Grönlandica. No. 455.

Eastport, Maine; Massachusetts Bay.
Cat. No. 243, New Brighton, England, Oct. 1860, H. J. Clark.
Cat. No. 244, Suisconset, Mass., L. Agassiz.
? Cat. No. 245, Nahant, Mass., Sept. 1854, H. J. Clark.

GRAMMARIA Stimps.

Grammaria Stimps. Mar. Inv. Grand Manan, p. 9. 1853.
Grammaria Agass. Cont. Nat. Hist. U. S., IV. p. 357. 1862.

Grammaria gracilis Stimps.

Grammaria gracilis Stimps. Mar. Inv. Grand Manan, p. 9. 1853.

Grand Manan (W. Stimpson).

Grammaria robusta Stimps.

Grammaria robusta Stimps. Mar. Inv. Grand Manan, p. 9, Fig. 3. 1853.

Grand Manan (W. Stimpson).

THUIARIA Flem.

Thuiaria Flem. British Animals. 1828.

Thuiaria thuja Flem.

Thuiaria thuja Flem. British Animals, p. 545. 1828.
Sertularia thuja Linn. Syst. 1308.
Thuiaria thuja Johnst. Brit. Zooph., p. 83.

Mingan Islands, N. S.
Cat. No. 240, Norway, M. Sars.
Cat. No. 420, Mingan Islands, N. S., Anticosti Expedition, 1861. Hydrarium.

Suborder TUBULARIÆ Agass.

Tubulariæ Agass. Cont. Nat. Hist. U. S., IV. p. 338. 1862.
Tubularina Ehrenb. Corall. d. Rothen Meeres.
Tubularina and *Hydrina* Johnst. Brit. Zooph., p. 29.

Family NEMOPSIDÆ Agass.

Nemopsidæ Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.

NEMOPSIS Agass.

Nemopsis Agass.; in Mem. Am. Acad., IV. p. 289. 1849.
Nemopsis McCr. Gymn. Charl. Harbor, p. 57.
Nemopsis Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.

Nemopsis Bachei Agass.

Nemopsis Bachei Agass.; in Mem. Am. Acad., IV. p. 289, Fig. 1849.
Nemopsis Bachei Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.
Nemopsis Gibbesi McCr. Gymn. Charl. Harb., p. 58, Pl. 10, Figs. 1–7.
Nemopsis Bachei A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 98, Figs. 26, 27.

Owing to the great changes through which Nemopsis passes before it reaches its adult form (compare Figs. 227–230), it is impossible to decide at present, before having seen the *Nemopsis Gibbesi* of McCrady, found at Charleston, whether he has not described again, under a new name, the *N. Bachei* found by Professor Agassiz in Vineyard Sound in 1848, and of which a wood-cut was published in the Memoirs of the American Academy for 1849. The circumstances under which the drawing was made precluded the possibility of great accuracy; it was a simple sketch; and as this Medusa has not been observed since, until the publication of McCrady's paper on the Medusæ of Charleston Harbor, it is not astonishing that he should have described it as a new species, having only for his guide that single wood-cut.

Fig. 227.

I have had, during the summer of 1861, the opportunity of observing this Medusa, at the time when it had only four tentacles to each marginal bulb (Fig. 227), no ovaries, and was not more than a sixteenth of an inch in diameter. The shape of the bell, and of the oral tentacles, the mode of branching of the digestive cavity and of the tentacles, agree so well with the drawings and descriptions of McCrady of similar stages in *N. Gibbesi*, that I am inclined to consider them as identical. The

Fig. 227. Youngest Nemopsis observed, having four tentacles at the base of each chymiferous tube.

only point which would throw some doubt upon this identification, is the time of the year at which it appears in Charleston and in Vineyard Sound; in the former place it is a winter species, found in December, while at Naushon it was very common in September. The marginal tentacles increase in the same way as in Bougainvillia; those which are nearest the middle of the bulb, at its apex, are developed first, and new tentacles are constantly growing near the base of the conical-shaped bulb. (Figs. 228, 229.) They are at first slender-pointed tentacles, but soon become rounded at the extremities, with sensitive eye-specks at the base, and change into contractile tentacles, having a slight swelling at the extremity; this swelling, however, depends very much upon the state of contraction of the tentacles. The adult frequently swim about with the marginal tentacles contracted to mere knobs, rising from the sensitive bulb (Fig. 229); during their movements, which are rapid and powerful, the oral tentacles (Fig. 230) are thrown up and down at each pulsation with great violence, and seem to be important appendages in directing the motions of the animal. With the exception that the tentacles, which are carried erect upon their base, are not contractile like the others, and have a more clavate appearance (Figs. 227–230), they differ in no way from the others. There are eye-specks at the base of the erect tentacles, as well as at the base of the contractile ones, and the supposition that in this genus the eyes were supported upon a peduncle, like the eyes of a lobster, was founded upon the dark club terminating this pair of tentacles; this color is due entirely to a thickening of the extremity by contraction. Male specimens have been found measuring more than half an inch in diameter. The proboscis projects well beyond the line of the genital organs (Fig. 231); at first, in young stages, the genital organs occupy but a very

Fig. 228.

Fig. 229.

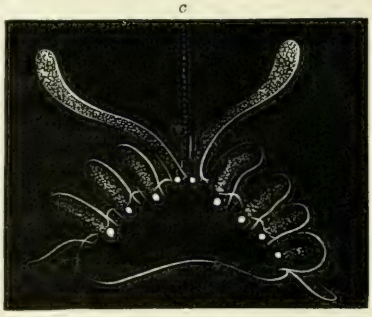


Fig. 230.

Fig. 228. Nemopsis somewhat more advanced than Fig. 227, having the second and third set of tentacles developed.

Fig. 229. Magnified view of the sensitive bulb at the base of one of the chymiferous tubes, *c*.

Fig. 230. Nemopsis in which the genital organs extend a considerable distance along the chymiferous tubes.

small portion of the upper part of the chymiferous tubes (Figs. 227, 228), but with advancing age extend farther down (Figs. 230, 231), and in the adult they reach the circular tube. The genital organs remind us, in their mode of growth, of what we find in Melicertum and Staurophora. The outline of the bell is but little changed from the earliest stages to the more advanced; it simply grows somewhat more globular. The sensitive bulb as well as the ovaries are slightly yellowish.

Fig. 231.

McCrady describes the Hydroid of this Medusa as a free floating community; I greatly incline to the opinion of Professor Allman, that we have in these free Hydroids nothing but the detached head of some Tubularian; certainly the figures given by McCrady of the Hydroid of Nemopsis, and by Stimpson of Acaulis, remind us very forcibly of detached heads of Tubularians. The heads of our Pennaria (*Globiceps tiarella* Ayres) frequently drop off, and nothing is more common than to see, at the time of breeding, several of these heads, covered with Medusæ, floating about in the jars where the Pennariæ are kept, and to have the Medusæ buds come to maturity while the head is thus detached, and would readily be mistaken for something like a free Hydroid. During four successive summers I have hunted in vain in the hope of finding one of these free Hydroids among the innumerable small Medusæ which must have just separated from the Hydrarium, which makes it probable that the Hydrarium is fixed, and not floating.

Vineyard Sound (L. Agassiz); Buzzard's Bay (A. Agassiz); Charleston Harbor (McCrady).

Cat. No. 44, Nantucket, Mass., June, 1849, L. Agassiz. Medusa.

Cat. No. 272, Naushon, Mass., Sept. 1861, A. Agassiz. Medusa.

ACAULIS Stimps.

Acaulis Stimps. Mar. Inv. Grand Manan, p. 10. 1853.
Acaulis Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.

Acaulis primarius Stimps.

Acaulis primarius Stimps. Mar. Inv. Grand Manan, p. 10, Pl. 1, Fig. 1.
Acaulis primarius Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.

Grand Manan (W. Stimpson).

Cat. No. 162, Grand Manan, W. Stimpson. Hydromedusarium.

Fig. 231. Magnified view of the genital organs, the actinostome, and the oral tentacles.

Family BOUGAINVILLEÆ Lütk.

Bougainvilleæ Lütk.; in Vidensk. Med., p. 29. 1849–50.
Bougainvillidæ Gegenb.; in Zeit. f. Wiss. Zool., p. 220. 1856.
Hippocrenidæ McCr. Gymn. Charl. Harbor, p. 56.
Bougainvillidæ Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Eudendroidæ Agass. Cont. Nat. Hist. U. S., IV. pp. 282, 342. 1862.

BOUGAINVILLIA Less.

Bougainvillia Less.; in Ann. des Sc. Nat., V. 1836.
Hippocrene Mert.; (Preocc. Moll.) in Mém. Acad. St. Petersburg, p. 229. 1835.
Hippocrene Agass.; in Mem. Am. Acad., p. 250. 1849.

Bougainvillia Mertensii Agass.

Bougainvillia Mertensii Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Hippocrene Bougainvillei Br. (*non* Less.); in Mém. Acad. St. Petersburg, p. 293, Pl. 20. 1838.

If the Hydrarium, collected at San Francisco, is the Hydrarium of *Bougainvillia Mertensii*, there can be no doubt of the specific difference between it and *Bougainvillia superciliaris* Agass. It grows quite luxuriously, attaining a height of nearly two and a half inches; the stems are very stout, particularly the main branch, which near the base is exceedingly robust; the branches are at least three times as stout as those of the Hydrarium of our Bougainvillia, which is slender, and always branches quite loosely. In the California species the branches succeed each other rapidly, and are crowded on the sides of the main stem. This would seem to prove that this species, like the *Coryne rosaria*, is the representative on the Pacific coast of its eastern congener, and that neither the *Coryne mirabilis* nor the *Bougainvillia superciliaris* are circumpolar species, like the *Toxopneustes drobachiensis*.

This species is undoubtedly the *Hippocrene Bougainvillei* Br. which Mertens found at Mathaei Island, in Behring's Strait, and which is figured in the Memoirs of the Academy of St. Petersburg for 1838, Vol. II. The ramifications of the tentacles surrounding the actinostome are very numerous, and the eye-specks at the base of the marginal tentacles small. The spherosome has a slight bluish tinge; the chymiferous tubes, the tentacles surrounding the mouth, and the marginal tentacles, are straw-colored; the base of the tentacles is yellowish-brown. This species is much larger than either *Bougainvillia superciliaris* or *B. macloviana;* it was quite common during the summer, in the harbor of Port Townsend, at the northwest boundary, in the

Gulf of Georgia, and was also found in the harbor of San Francisco during May and November.

Behring's Strait (Brandt); Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 33, San Francisco, Cal., March, 1859, A. Agassiz. Hydrarium.

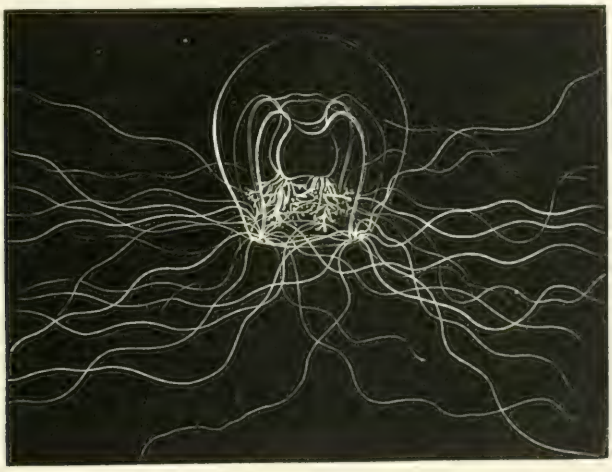
Cat. No. 49, Gulf of Georgia, W. T., May, 1859, A. Agassiz. Medusa.

Bougainvillia superciliaris Agass.

Bougainvillia superciliaris Agass. Cont. Nat. Hist. U. S., IV. pp. 289, 291, Figs. 37–39; p. 344, Pl. 27, Figs. 1–7. 1862.
Hippocrene superciliaris Agass.; in Mem. Am. Acad., IV. p. 250, Pls. 1–3.
Hippocrene superciliaris Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Bougainvillia superciliaris A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. Figs. 24, 25.
Hippocrene Bougainvillei Gould (*nec* Br., *nec* Less.). Rep. Inv. Mass., p. 348. 1841.
? *Tubularia ramosa* Gould. Rep. Inv. Mass., p. 350. 1841.
? *Eudendrium cingulatum* Stimps. Mar. Inv. Grand Manan, p. 9. 1853.

The development of the young Medusæ of the species, formerly referred to Bougainvillia, shows beyond doubt that the genera Bougainvillia and Margelis are founded upon structural differences; from the earliest stages we can trace the peculiar short and long digestive cavities so characteristic of these two genera, as well as the differences in the form of the bell. *Bougainvillia superciliaris* (Fig. 232), of which a

Fig. 232.



complete description has already been given by Professor Agassiz, in the Memoirs of the American Academy for 1849, is one of our most common Medusæ, but readily escapes notice on account of its small size. The Hydrarium (Fig. 233) has also been figured by Professor Agassiz in Vol. IV. of his Contributions, but the development has not been traced before. The Medusæ buds are found along the stem below the heads; Figs. 234, 235 are early stages, when the bell is elongated, and inca-

Fig. 232. Magnified profile view of adult Bougainvillia superciliaris.

pable of expansion and contraction. In Figs. 236, 237, which are somewhat older Medusæ in different attitudes, the digestive cavity is well

Fig. 233.

Fig. 234.

Fig. 235.

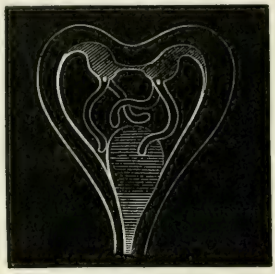


Fig. 236.

developed, and from the four corners of the actinostome bulge out four club-shaped appendages, the first traces of the oral tentacles. There

Fig. 237.

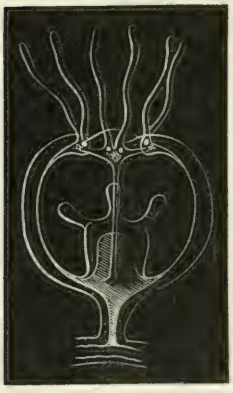
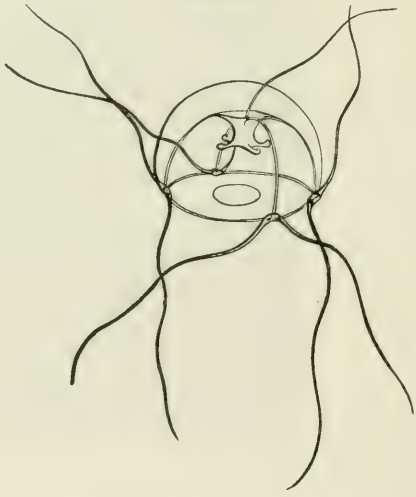


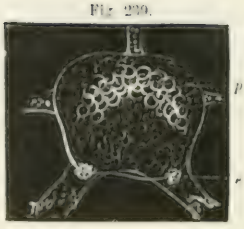
Fig. 238.



are two well-developed tentacles, which were at first a mere knob, with distinct eye-specks. (Fig. 234.) The bell is quite thin at this stage, and

Fig. 233. Hydromedusarium of Bougainvillia superciliaris.
Fig. 234. Young elongated Medusa.
Fig. 235. Somewhat more advanced than Fig. 234.
Fig. 236. Appearance a short time before separating from the stem, in a contracted state.
Fig. 237. The same as Fig. 236, expanded.
Fig. 238. Young Bougainvillia, immediately after its liberation from the Hydromedusarium.

Fig. 239.



of uniform thickness, the veil large and powerful; the abactinal portion of the bell becomes somewhat more thickened, and when it has separated from the Hydrarium (Fig. 238), the tentacles far exceed in length the diameter of the bell, the sensitive bulb (Fig. 239) having become quite well defined in outline; it is somewhat quadrangular, filled with dark pigment cells, *p*, and at the base of each tentacle a bright eye-speck, *e*, is formed; the club-shaped oral appendages soon begin to branch, additional tentacles appear in pairs on each side of the original pair (Fig. 240), and the young Medusa soon assumes all the principal features of the adult, as in Fig. 232, with the exception of the simpler character of the tentacles of the actinostome.

Fig. 240

Massachusetts Bay (Agassiz).

Cat. No. 27, Nahant, Mass., Sept. 1854, H. J. Clark. Hydrarium.
Cat. No. 28, Beverly, July, 1861, A. Agassiz. Hydromedusarium.
Cat. No. 29, Nahant, July, 1861, A. Agassiz. Hydrarium.
Cat. No. 30, Newport, R. I., Prof. J. Leidy. Hydromedusarium.
Cat. No. 31, Newport, R. I., S. Powell. Hydromedusarium.
Cat. No. 408, Nahant, July, 1862, A. Agassiz. Hydromedusarium.
Cat. No. 447, Nahant, July, 1864, A. Agassiz. Hydromedusarium.
Museum Diagrams, Nos. 20, 22, after A. Agassiz.

MARGELIS Steenst.

Margelis Steenst.; in Vidensk. Medel. for 1849–50, p. 43.
Margelis Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Bougainvillia Less.; in Ann. Sc. Nat., V. 1836.
Hippocrene McCr. (*nec* Mert. *nec* Agass.). Gymn. Charl. Harb., p. 61.

The structural differences observed in the European *Bougainvillia britannica* Forbes, and the *Hippocrene carolinensis* McCrady, seem sufficient to separate them from the genus Hippocrene, as has been proposed by McCrady. The digestive cavity, instead of being a short, rounded sac, attached at some distance below the highest point of the chymiferous tubes, is long and slender, swelling slightly towards its actinal end, and attached at the point of junction of the chymiferous tubes; the peduncle of the actinostome is long, the oral tentacles branch only two or three times; these are more than specific differences; they are structural differences, unlike the differences we find between species of the genus Bougainvillia, as between the

Fig. 239. Magnified view of sensitive bulb. *p*, pigment-cells; *e*, eye-speck.
Fig. 240. Tentacular bulb with the young tentacles. *c*, chymiferous tube; 1, 2, 3, 4, different sets of tentacles.

Hippocrene superciliaris of the northeast coast, and the *Hippocrene Mertensii* of the northwest coast, which are differences in the proportion of the digestive cavity, its position, the thickness of the bell, and the mode of branching of the oral tentacles.

Margelis carolinensis Agass.

Margelis carolinensis Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Hippocrene carolinensis McCr. Gymn. Charl. Harbor, p. 62, Pl. 10, Figs. 8–10.

Adult females, taken at Naushon in September, measured about one third of an inch (Fig. 241); the main stem of the four oral tentacles

Fig. 241.

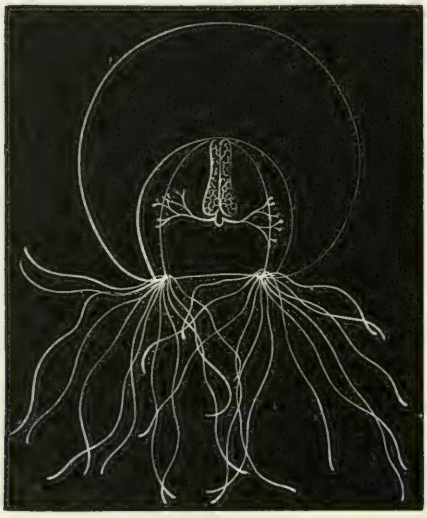
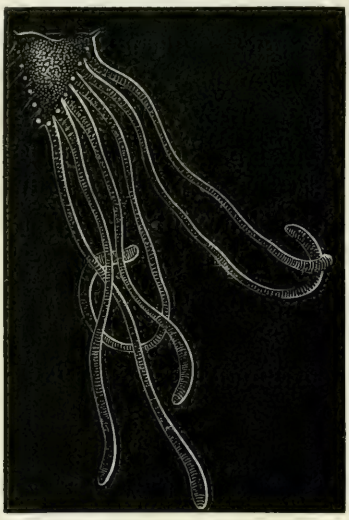


Fig. 243.



branches twice, and each of these branches twice (Fig. 242); the cavity of the bell is small and globular; the marginal bulbs are large and conical, and give rise (Fig. 243) to ten or twelve tentacles, which are long, slender, and not usually carried curled up tightly near the bulb; the bulb is colored with brilliant red pigment-cells, surrounded by a green edge, bordered with bright yellow, and in the yellow border are placed the black eye-spots, giving to the base of the tentacles a very striking appearance; the digestive cavity is brick red, and when the folds of the genital glands are expanded by eggs, they hang down in four pouches, so as to hide the peduncle of the digestive cavity. (Fig. 242.) The outline of

Fig. 242

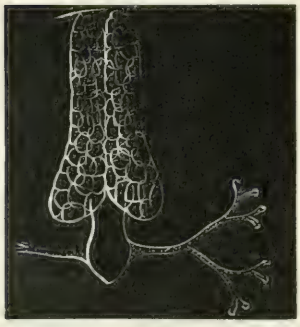


Fig. 241. Adult Margelis, seen in profile; magnified.
Fig. 242. Digestive cavity, genital pouches, oral tentacles, and actinostome.
Fig. 243. Sensitive bulb at base of one of the chymiferous tubes.

the bell is almost spherical; the thickness of the disk is so great that the cavity of the bell only extends to half the height of the vertical axis. (See Fig. 241.)

In young specimens (one tenth of an inch in height) just liberated from the Hydromedusarium, the outline of the disk is bell-shaped (Fig. 244), the cavity of the bell is large in proportion, and the thickness of the upper part of the bell is not one third of the height of the actinal axis. The digestive cavity and the peduncle are one; it is bottle-shaped, cylindrical, and not yet divided by four longitudinal furrows into genital pouches. These small Medusæ have, like the young of Bougainvillia, when freed from the Hydromedusarium, but two tentacles at the base of each of the chymiferous tubes (Figs. 244, 245), the

Fig. 244.

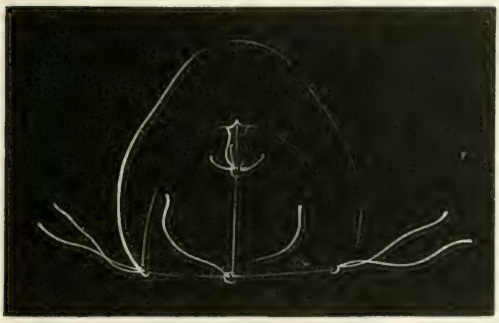
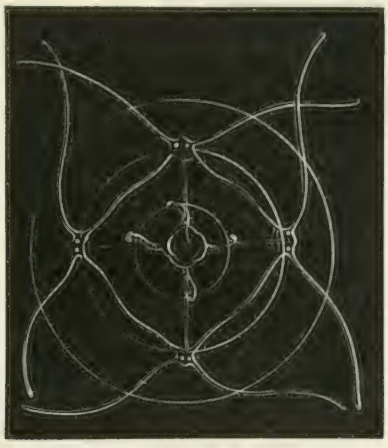


Fig. 245.



digestive cavity terminates likewise with perfectly simple, stiff oral tentacles, which begin to branch only in somewhat more advanced stages. The generic identity of *Bougainvillia britannica* with our *Margelis carolinensis* is perhaps not better shown than by the agreement of the young Medusæ in all their essential features, while the Hydrarium shows that the specific difference between the English and American representatives is not to be questioned. See the observations of Dalyell on the development of his *Tubularia ramosa*, Pl. XI. Vol. I., Animals of Scotland, and the figures of Hodge of *Podocoryne Alderi*, which I presume is only a young of one of the species of Bougainvillia (Margelis Steenst.) of Forbes. It seems therefore perfectly justifiable to reconstruct the genus Bougainvillia in such a way as to separate from it those species which have a long, slender digestive cavity, with but slightly branching tentacles, under the name of Margelis.

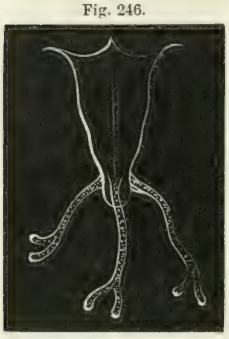
The oral tentacles are, in the youngest Medusæ (Fig. 244), small,

Fig. 244. Young Margelis, having only two marginal tentacles at the base of each chymiferous tube, and simple oral tentacles.

Fig. 245. Young Margelis, seen from the abactinal pole, in the condition of Fig. 244.

simple tentacles, terminating with a cluster of lasso-cells; in somewhat older Medusæ the oral tentacles have two branches, as in Fig. 246, when there are six tentacles to each marginal bulb, with a small bundle of lasso-cells at the extremity. As the young Medusa grows, the bell loses its conical shape, and becomes more spherical. The marginal tentacles of the young are carried curved inwards towards the veil; as they increase in length they lose this tendency, and are stretched out in every direction. The additional tentacles are added at the base of the conical bulb, those which are near the apex being always the longest and oldest.

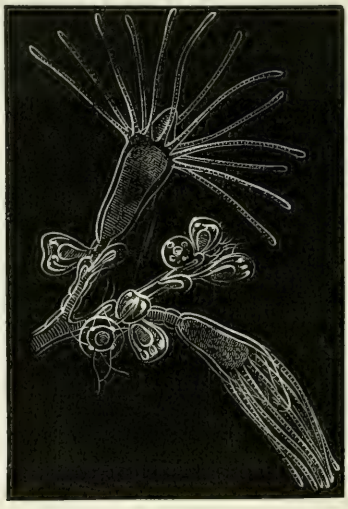
Fig. 246.



The Hydrarium (Fig. 247) grows to a very large size, from eight to twelve inches in height; it resembles in its general mode of branching *Eudendrium ramosum*. The main stem is stout, and tapers gradually; the main branches begin close to the root, and thus form clusters of stems, from which branch off irregularly secondary branches, which are quite slender, and ramify but little. The Hydræ are very large, and quite closely packed together, growing with equal profusion on the main stem and on the

Fig. 247.

Fig. 248.



branches. The Hydrarium is found growing attached to *Fucus vesiculosus* in great abundance. The general color of the main stem is somewhat grayish green, the Hydræ are of a delicate rosy tint. The Medusæ buds are developed, somewhat as in our *Bougainvillia superciliaris*, along the stem (Fig. 248), without, however, being limited to the proximity of the Hydra head, as the Medusæ make their appearance

Fig. 246. Proboscis of a Margelis, having already six tentacles at each sensitive bulb.
Fig. 247. Hydrarium of Margelis carolinensis, greatly reduced in size.
Fig. 248. Magnified heads and Medusæ buds of Margelis carolinensis.

all over the stem, resembling in this respect very strikingly the Perigonimus of Sars, to which the Hydrarium also bears a close affinity, from the size of its sterile Polypes.

Charleston Harbor (McCrady); Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 43, Naushon, Mass., Sept. 1861, A. Agassiz. Hydrarium.

Cat. No. 437, Naushon, Mass., 1864, A. Agassiz. Medusa.

EUDENDRIUM Ehrenb.

Eudendrium Ehrenb. Corall. d. Roth. Meeres. 1834.
Eudendrium Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.
Calamella Oken. Lehrb. der Naturg. Gesch. 1815.
Thoa Lamx. Pol. Cor. Flex. 1816.

Eudendrium dispar Agass.

Eudendrium dispar Agass. Cont. Nat. Hist. U. S., IV. pp. 285, 289, 342, Fig. 36; Pl. 27, Figs. 10–21. 1862.
Thoa dispar Agass. Cont. Nat. Hist. U. S., IV. Pl. 27, Figs. 10–16. 1862.

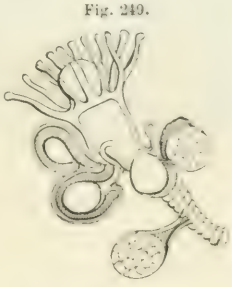


Fig. 249.

This Hydroid (Fig. 249) is closely allied to the *Tubularia ramea* of Dalyell and the *Coryne pusilla* var. *muscoides* of Johnston. The male and female communities are readily recognized by the different color of the Medusæ buds; the male Medusæ buds are bright orange, while the females are of a dull pink.

Massachusetts Bay (Agassiz).

Cat. No. 34, Nahant, Mass., Sept. 1854, H. J. Clark. Hydrarium.

Cat. No. 35, Suisconset, Mass., July, 1849, L. Agassiz. Hydrarium.

Cat. No. 36, Nahant, July, 1861, A. Agassiz. Hydrarium.

Cat. No. 37, Nahant, July 11, 1861, A. Agassiz.

Cat. No. 38, Naushon, Mass., September, 1861, A. Agassiz.

Cat. No. 405, Nahant, June, 1862, A. Agassiz. Hydromedusarium.

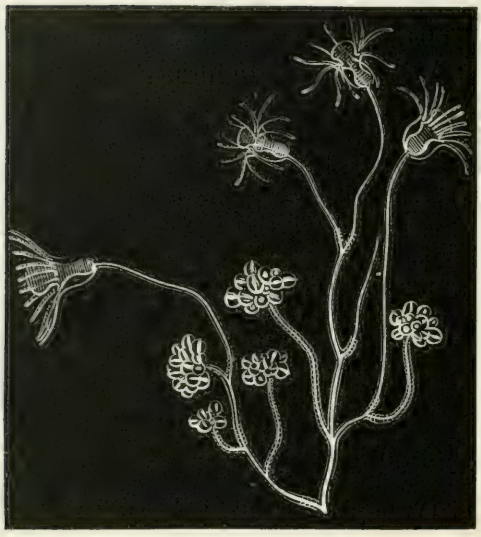
Cat. No. 423, Eastport, Me., A. E. Verrill.

Museum Diagram No. 23.

Fig. 249. Female Medusæ buds in different stages of development.

Eudendrium tenue A. Agass.

Fig. 250.



This species (Fig. 250) can at once be distinguished from the *E. dispar* Agass. (Fig. 249) by its large clusters of Medusæ, while in the *E. dispar* the Medusæ buds are always somewhat scattered, and never clustered together, as in *E. tenue*. This is quite a small species, the tallest specimens hardly rising more than an inch to an inch and a half, while the *E. dispar* is a large Hydroid, growing in tall stems, branching but little; the *E. tenue*, on the contrary, forms small colonies of densely crowded individuals, branching profusely. The color is light pinkish.

Massachusetts Bay, Nahant (A. Agassiz); Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 39, Naushon, Sept. 1861, A. Agassiz. Hydrarium.
Cat. No. 40, Suisconset, July, 1849, L. Agassiz. Hydrarium.
Cat. No. 41, Suisconset, July, 1849, L. Agassiz. Hydrarium.
Cat. No. 402, Nahant, June 17, 1862, A. Agassiz. Hydromedusarium.

Eudendrium ramosum McCr.

Eudendrium ramosum McCr. Gymn. Charleston Harbor, p. 64.
? *Eudendrium ramosum* Johnst. Brit. Zooph., p. 46.

McCrady has identified this species with the English *E. ramosum* Johnst. Specimens collected at Charleston by Professor Clark certainly show a great similarity to the English species, but it still remains to be proved, as we do not know their development, that these species are identical.

Charleston, S. C. (McCrady).

Cat. No. 42 Charleston, S. C., December, 1861, H. J. Clark.

Fig. 250. A part of a male colony; magnified.

LIZZIA Forbes.

Lizzia Forbes. Brit. Naked-eyed Medusæ, p. 64. 1848.
Lizzia Agass. Cont. Nat. Hist. U. S., IV. p. 345. 1862.
Cytæis Sars (*non* Esch.). Beskriv., p. 28. 1835.

Lizzia grata A. Agass.

Lizzia grata A. Agass.; in Proc. Bost. Soc. Nat. Hist., p. 100, Figs. 28, 29. 1862.

The presence of a cluster of tentacles, intermediate between the chymiferous tubes gives to Lizzia a totally different aspect from that of Bougainvillia, which is the permanent embryonic type of Lizzia. In a young Lizzia this middle cluster is wanting; the character of the development of the tentacles is totally different from that of Bougainvillia; we have an odd tentacle at first (Fig. 252), and then pairs of

Fig. 252.

Fig. 251.

Fig. 253.

tentacles (Fig. 253), while in the Bougainvillia we have, for the first set, as well as for the subsequent cycles, a pair of tentacles; so that we may have, as members of the same family, forms in which these clusters are reduced to a minimum, as in Dysmorphosa (Fig. 259), where the odd tentacle alone is developed.

In an adult Lizzia (Fig. 251) the chymiferous cluster of tentacles consists of five, the intermediate cluster of three. The order of succession of the different tentacles in the young stages can easily be traced in Fig. 252; at first there are four long tentacles opposite the chymiferous tubes, flanked by two short tentacles; next the odd tentacle of the middle cluster makes its appearance, and then after some time the other pair of tentacles of the middle cluster. The sensitive bulb of the adult is elongated, polygonal, and thickly covered with pigment-cells (*p*, Fig. 253); the digestive cavity of the adult (Fig. 254) is nearly as long as the cavity of the bell, into which a short projection of the bell

Fig. 251. Adult male Lizzia grata, seen in profile; magnified.
Fig. 252. Quarter of the disk of a young Lizzia.
Fig. 253. Magnified view of the sensitive bulb. *p*, pigment-cells.

extends; the genital pouches are on the sides of the digestive cavity, extending nearly to its extremity. The actinostome terminates in four large lobes, edged with short oral tentacles, surmounted by a knob of

Fig. 254.

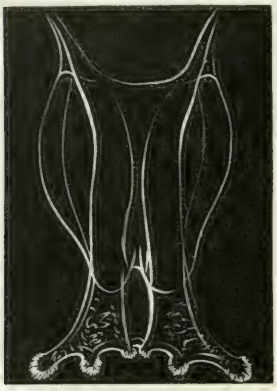
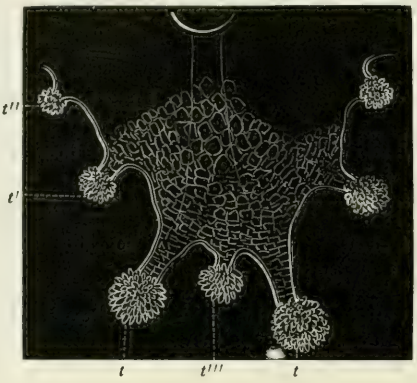


Fig. 255.



lasso-cells; these lips are quite expansive and contractile. (t, t', t'', t''', Fig. 255.) In the young Medusæ the digestive cavity terminates with only four club-shaped tentacles (t, Fig. 256); this soon branches in

Fig. 256.

Fig. 257.

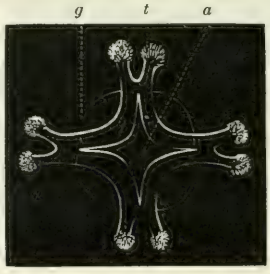


Fig. 258.

somewhat older stages, as that of Fig. 252, and assumes the shape of Figs. 257, 258, t, additional club-shaped oral tentacles being added in the order in which they are numbered in Fig. 255.

Massachusetts Bay (A. Agassiz).

Cat. No. 446, Nahant, A. Agassiz. Medusa.

Fig. 254. Proboscis of male Lizzia; magnified.

Fig. 255. One of the four lobes of the actinostome, seen from above. t, t, t', t'', t''', tentacles of actinostome.

Fig. 256. Actinal view of the proboscis of a young Lizzia. t, oral tentacle; d, digestive cavity.

Fig. 257. Actinal view of proboscis of an older specimen. a, actinostome; g, genital pouches; t, tentacles of actinostome.

Fig. 258. Abactinal view of Fig. 257, somewhat less magnified, with the oral tentacles in a different attitude; lettering as above.

DYSMORPHOSA Phil.

Dysmorphosa Phil.; in Archiv f. Nat., p. 37. 1842.
Podocoryne Sars. Fauna Lit., p. 4. 1846.

Sars has traced the development of a Medusa from *Podocoryne carnea* which is very closely allied to *Dysmorphosa fulgurans* here figured. It corresponds, in its younger stages, while still attached to the proboscis of its parent, to the different stages of our Medusa, in the number, arrangement, and order of appearance of the tentacles, so completely, that I have referred it to the genus Dysmorphosa of Philippi, considered by Sars as identical with the Hydroid from which his Medusa was developed. This identification is the more probable, as Krohn has given us a complement to the observations of Sars on the adult Medusæ, and traced the budding from the proboscis in exactly the same manner as it is here given. The Lizzia figured by Claparède in the tenth volume of Siebold u. Kölliker's Zeitschrift, in which he has also traced the budding from the proboscis, appears to be identical with the *Podocoryne carnea* of Sars.

Dysmorphosa fulgurans A. Agass.

This Medusa (Fig. 259) is sometimes so abundant that the whole sea, when disturbed, is brilliantly lighted by the peculiar bluish phosphorescent color which they give out. Their great number is easily accounted for by their mode of reproduction and by its rapidity. Young Medusæ are formed by budding on the upper extremity of the proboscis (Figs. 259, 260), and their development takes place in the course of three or

Fig. 259

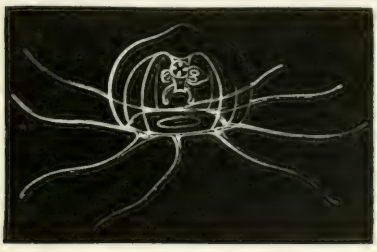
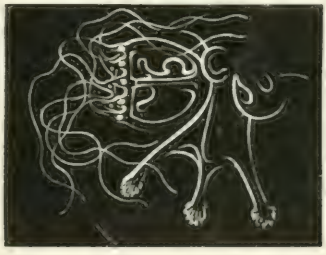


Fig. 260



four days; from three to four Medusæ develop at the same time; the Medusæ buds of the third generation are already forming, while the second is still attached. (Fig. 260.) The young Dysmorphosa has at first four tentacles, the middle set developing later; there are only four oral tentacles, quite long and slender, and an accumulation of pigment-

Fig. 259. Adult Dysmorphosa; magnified.
Fig. 260. Magnified proboscis, showing young Medusæ of the second and third generations.

cells at the base of the tentacles; the abactinal part of the bell is quite conical (Fig. 259); the tentacles of the adult Medusa are usually carried rather stiffly (Fig. 260); but when the young Medusa is still attached, they are frequently expanded several times the diameter of the bell. (Fig. 260.) This Medusa resembles very much the young of *Turritopsis nutricula*, and could readily be mistaken for it. It would be most natural, therefore, to place this genus in the family of Nucleiferæ; but the presence of the peculiar oral tentacles of Lizzia, added to the fact that this is probably only a permanent embryonic stage of Lizzia, induces me to place it among the Bougainvillidæ.

Allman describes, in the fourth volume of the Ann. & Mag. of N. H. for 1859, page 368, a Medusa as developing from *Laomedea tenuis*, which resembles so strikingly Lizzia and Dysmorphosa that I suspect there must be some error in his observation. Does it not rather come from his *Dycoryne stricta*, which he found at the same time and at the same place, and which would thus bring this Medusa, intermediate in its characters between Lizzia and Dysmorphosa, to its proper place among the Bougainvillidæ?

Massachusetts Bay, Nahant (A. Agassiz); Buzzard's Bay, Naushon (A. Agassiz).

Family NUCLEIFERÆ Less.

Nucleiferæ Less. Prod. Mon. Méd. 1837.
Nucleiferæ Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1862.
Oceanidæ Esch. (*p. p. non* Agass.). Syst. der Acal., p. 96. 1829
Oceanidæ Gegenb.; in Zeitschrift f. Wiss. Zool., p. 219. 1856.
Oceanidæ McCr. Gymn. Charleston Harbor, p. 21.
Clavidæ McCr. Gymn. Charleston Harbor, p. 37.
Clavidæ Agass. Cont. Nat. Hist. U. S., IV. p. 338. 1862.

TURRIS Less.

Turris Less. Prod. Mon. Méd. 1837.
Turris Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1862.
Oceania Auct. (*p. p. non* Agass.). Medusa.
Clavula Wright. Hydra.

Turris vesicaria A. Agass.

Turris vesicaria A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 97.

This Medusa I formerly supposed to be the *Medusa digitalis* of Fabricius; it certainly is not that of Forbes. Since that time I have ascertained that the *Medusa digitalis* of Fabricius belongs to a different family, the Trachynemidæ. (See page 57.) It has been found but once at Nahant, in the early part of the spring, and probably

having habits similar to those of Tima, it is only accidentally met with. It has very much the same kind of coloring as our Tima, but in Turris the color of the genital organs and the base of the tentacles is somewhat more yellowish. The bell of Turris is exceedingly

Fig. 261

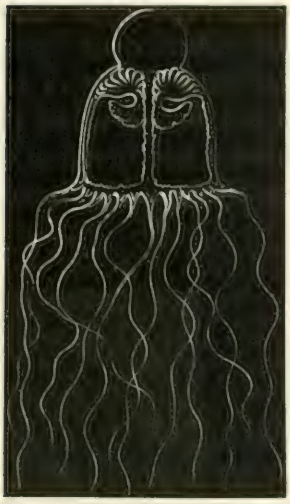


Fig. 262.

thin, except at the abactinal pole (Fig. 261), where it forms a sort of bladder, capable of more or less contraction at its base; when the Medusa is disturbed, the sides of the bell, below the bladder, contract, and give it a polygonal outline, as is seen in Fig. 262. The genital

Fig. 263

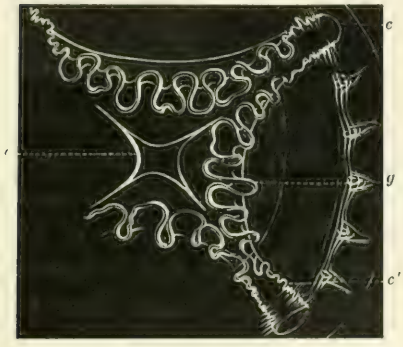
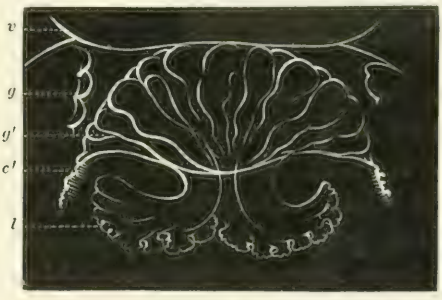


Fig. 264.



organs remind us somewhat of those of Ptychogena, only they are attached to the abactinal part of the interior of the bell; passing in

Fig. 261. Turris vesicaria, natural size; seen in profile.

Fig. 262. The same, with the bell contracted.

Fig. 263. A portion of the disk, seen from the abactinal pole. *a*, opening of actinostome; *g*, point of attachment of the convoluted genital organs to the inner surface of the bell; *c*, chymiferous tubes; *c'*, continuation of convolution of genital organs, forming the sides of the chymiferous tubes.

Fig. 264. Magnified profile view of genital organs and actinostome. *l*, lips of actinostome; *g'*, convoluted genital organs, extending from one side of the bell to the other; *g*, part of the genital organ on the other side of the chymiferous tube; *c'*, as in Fig. 263; *v*, base of bladder surmounting the bell.

deep festoons (Fig. 263) from one chymiferous tube to another; they form a compact mass, and fill the whole of the upper part of the bell; from this are suspended four movable, deeply-frilled lips (*l*, Fig. 264), leading into a short digestive cavity totally concealed by the genital organs. The chymiferous tubes are broad and very flat, the two edges of the tubes being irregularly cut (Fig. 265); transverse folds extend from one side to the other; the chymiferous tubes open into a broad circular tube (Fig. 266), having a similar hacked edge; with the circular tube communicate five tentacles placed between the chymiferous tubes, and one opposite each. The tentacles are broad at the base, and taper very rapidly into a long slender lash; at the base of

Fig. 266.

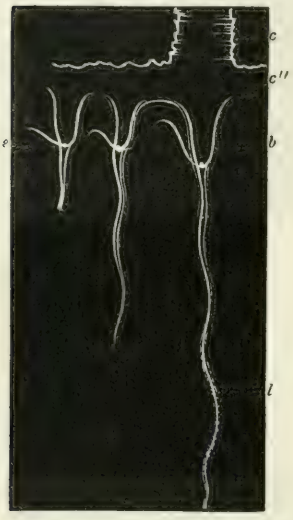


Fig. 267.

Fig. 265.

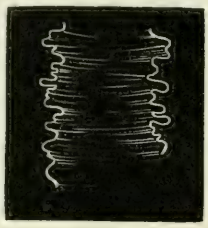
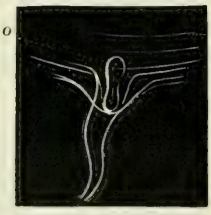


Fig. 268.



the bag of the tentacles is a large swelling, in the centre of which is placed a distinct eye-speck. (Figs. 266, *e*; 267, 268.) The size of the opening, leading from the circular tube to the tentacle, is readily seen when examined from the abactinal side. (Figs. 263; *o*, 268.) In the genera Turris, Ptychogena, Olindias of Müller, and Polyorchis, we have strongly developed characters, which show their close relation; in Turris and Ptychogena, the nature of the genital organs and the character of the chymiferous tubes; in Olindias and Polyorchis, the genital organs and branching tubes, being simply extreme cases of what we have first hinted at in Turris, more strongly marked in Ptychogena, in the mode of attachment of the genital organs, and

Fig. 265. Magnified view of a part of a chymiferous tube.

Fig. 266. Base of one of the chymiferous tubes, and part of the circular tube. *c*, chymiferous tube; *c''*, circular tube; *b*, sensitive bulb of tentacle; *e*, eye-speck; *l*, lash of the tentacles covered with lasso-cells.

Fig. 267. One of the tentacles in a semi-profile view.

Fig. 268. One of the tentacles, seen from the abactinal pole. *o*, opening leading from circular tube.

carried out in a very different direction in the genital pouches on the pendent proboscis of Stomotoca.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 274, Nahant, Mass., May 12, 1862, A. Agassiz.

TURRITOPSIS McCr.

Turritopsis McCr. Gymnoph. Charleston Harbor, p. 24. 1857.
Turritopsis McCr. On Turritopsis, new species, ... p. 2. 1856.
Turritopsis Agass. Cont. Nat. Hist. U. S., IV. p. 347. 1862.

Turritopsis nutricula McCr.

Turritopsis nutricula McCr. Gymn. Charleston Harbor, p. 25, Pls. 4, 5, 8, Fig. 1.
Turritopsis nutricula Agass. Cont. Nat. Hist. U. S., IV. p. 347. 1862.
Turritopsis nutricula A. Agass.; in Proc. Boston Soc. Nat. Hist., IX. Figs. 22, 23.

The young Medusæ have only four stiff tentacles, with a long bottle-shaped digestive trunk (Fig. 269), fastened by its base to the lower part of a short prolongation of the bell, along which the chymiferous tubes run; the digestive cavity has four marked prolongations, surmounted by bunches of lasso-cells; along the upper part of the digestive cavity, the genital organs are developed in four bunches, placed along the prolongations of the actinostome. As the Medusæ increase in size, there are four more tentacles formed, one in the middle of the space between the chymiferous tubes; the genital organs increase in length, and by the time two additional tentacles (3, Fig. 270) have been formed, one on each side of the tentacles of the second cycle, the genital glands have become very much swollen, and occupy nearly the whole length of the digestive cavity and proboscis. With advancing size the gelatinous mass loses its bell shape, and becomes more globular, the tentacles (then sixteen in number) losing somewhat their stiffness; when it has only four tentacles, the young Medusa resembles so much Sarsia, in the shape of the bell and of the digestive cavity, that were it not that Sarsia carries its tentacles curled up close to the circular tube, while in Turritopsis they stand stiffly out from the rim of the bell, like the tentacles of Eudendrium, it would be difficult to distinguish them apart. Not having traced this Medusa beyond the stage when it had sixteen

Fig. 269.

Fig. 270.

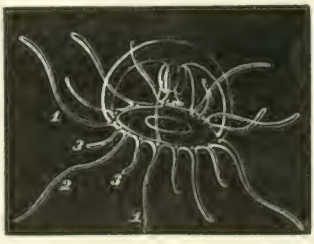


Fig. 269. Young Turritopsis nutricula, with four marginal tentacles; greatly magnified.
Fig. 270. Somewhat more advanced Turritopsis, having sixteen tentacles.

tentacles. I am unable to determine whether it is a distinct species from the Turritopsis of Charleston; the color of the proboscis and of the sensitive bulb is different in the two; the ovaries are light brown, with darker lines in the furrows between them; the ocelli are dark-red brown. The shape of the tentacles and of the bell, however, are the same in both, as well as their habits, and the changes which this Medusa goes through with advancing age. From each side of the base of the four tentacles, at the junction of the circular and of the chymiferous tubes, runs a thread of bunches of lasso-cells, which reach nearly to the abactinal pole, as in the young Medusæ of many of the Tubularians.

There is found at Nahant the young of a species of Turritopsis which differs from the *Turritopsis nutricula* very essentially; the bell, which is remarkably thin, has a uniform thickness from the circular tube to the abactinal pole; the tentacles, even when there are only four, are quite long, slender, and usually carried curled up along the sides of the bell, giving these young Medusæ a totally different aspect from the young of the *T. nutricula.* I might mention here that the trace of its connection with a Hydroid stock was very distinct in young Medusæ; the adult Medusa was not observed.

Charleston, S. C. (McCrady); Naushon, Buzzard's Bay (A. Agassiz).

Cat. No. 273, Naushon, September, 1861, A. Agassiz. Medusa.

Cat. No. 440, Naushon, July, 1864, A. Agassiz. Medusa.

STOMOTOCA Agass.

Stomotoca Agass. Cont. Nat. Hist. U. S., IV. p. 347. 1862.
Saphenia Forbes (*non* Esch.). British Naked-eyed Medusæ, p. 25. 1848.

Stomotoca apicata Agass.

Stomotoca apicata Agass. Cont. Nat. Hist. U. S., IV. p. 347. 1862.
Saphenia apicata McCr. Gymn. Charleston Harbor, p. 27, Pl. 8, Figs. 2, 3.

Charleston, S. C. (McCrady); Newport (A. Agassiz).

Cat. No. 454, Newport, A. Agassiz. Medusa.

Stomotoca atra Agass.

Stomotoca atra A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 347. 1862.

This Medusa (Fig. 271) is much larger than the one Forbes has described as *S. dinema* (Naked-eyed Medusæ, Pl. II. Fig. 4), which measures only a quarter of an inch, while this species is from three quarters to an inch in size; it is much less elongated, the vertical and horizontal diameters being the same; it swells out to its greatest horizontal diam-

eter almost immediately above the circular tube, where it curves in slightly, and then bends uniformly towards the abactinal pole; the upper part is almost hemispherical, being very blunt at the abactinal pole; the peduncle tapers gradually from the base to the ovaries; the ovaries are barrel-shaped, extending to the digestive cavity, which is small at the point where the chymiferous tubes empty into it, but gradually bulges out, and passes into the lobes of the actinostome, where it is three or four times as wide as at the base. Only two of the chymiferous tubes have long tentacles; between these larger tentacles there are a number of small tentacles (in the specimen described about eighty), hardly one sixteenth of an inch long. The ovaries are placed on the abactinal extremity of a long peduncle; they consist of a double series of folds, occupying the middle third of the peduncle (Fig. 272), and are of a dark-brown color; below them is placed the digestive cavity, which is very contractile, of a lighter color, and end-

Fig. 271.

Fig. 273.

Fig. 272.

ing with an actinostome divided into four lips. While swimming, these Medusæ move slowly, contracting alternately either one or the other of their long tentacles; when contracted, the tentacle has very much the appearance of the contracted tentacle of a Pleurobrachia; when floating about motionless, the chymiferous tubes often contract, and this gives to the Medusa the appearance of being deeply lobed (Fig. 273), the intermediate portions of the periphery not seeming to be so highly contractile as that which immediately adjoins the chymiferous tubes. This Medusa was quite common in the Straits of Rosario, W. T., in the beginning of June. I also found specimens of it during the summer, till September, in different parts of the Gulf of Georgia, and in the neighborhood of Port Townsend.

Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 50, Straits of Rosario, W. T., June, 1859, A. Agassiz. Medusa.

Fig. 271. Stomotoca atra, somewhat magnified; seen in profile.
Fig. 272. Magnified view of genital organs.
Fig. 273. Stomotoca atra, in a different attitude.

RHIZOGETON Agass.

Rhizogeton Agass. Cont. Nat. Hist. U. S., IV. p. 347. 1862.

Rhizogeton fusiformis Agass.

Rhizogeton fusiformis Agass. Cont. Nat. Hist. U. S., IV. pp. 224, 347, Pl. 20, Figs. 17–23. 1862.

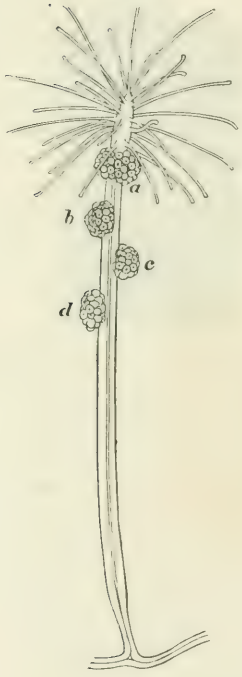
Massachusetts Bay (Agassiz).

Cat. No. 52, Nahant, Mass., July, 1861, A. Agassiz. Hydrarium.

CLAVA Gmelin.

Clava Gmelin; in Beschäft. d. Berlin. Ges. Naturf. Freunde. 1775.

Fig. 274.



Clava leptostyla Agass.

Clava leptostyla Agass. Cont. Nat. Hist. U. S., IV. pp. 218, 222, Fig. 32; 338, Pl. 20, Figs. 11–16ª; Pl. 21. 1862.
Clava multicornis Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Clava multicornis Leidy. Mar. Inv. Rhode Island and New Jersey, p. 3, Pl. XI. Figs. 33, 34. 1855.
Clava multicornis Pack.; in Can. Nat. & Geol. Dec. 1863.

The *Clava leptostyla* (Fig. 274) seems to differ from the *C. multicornis* by the greater number of its tentacles.

Point Judith (Leidy); Massachusetts Bay (Agassiz).

Cat. No. 51, Kingston, Mass., July, 1851, H. J. Clark.

Cat. No. 451, Nahant, Mass., A. Agassiz. Hydromedusarium.

Museum Diagram, No. 24, after L. Agassiz.

Fig. 274. Clava leptostyla; greatly magnified.

Family WILLIADÆ Forbes.

Williadæ Forbes. British Naked-eyed Medusæ, p. 19. 1848.
Berenicidæ Agass. (*p. p. non* Esch.). Cont. Nat. Hist. U. S., IV. p. 345. 1862.

WILLIA Forbes.

Willsia Forbes. British Naked-eyed Medusæ, p. 19. 1848.
Willia Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1862.

Willia ornata McCr.

Willia ornata McCr. Gymnoph. Charleston Harbor, p. 47, Pl. 9, Figs. 9–11.
Willia ornata Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1862.
Willia ornata A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. Figs. 20, 21. 1862.

The development of Willia presents some striking differences from the mode in which tentacles are regularly developed in successive cycles among Polyps, and from what has been observed, in accordance with that mode of development, among some of our naked-eyed Medusæ (*Laomedea diaphana*, *Clytia bicophora*, etc.). In very young Williæ, having only four simple chymiferous tubes and four tentacles, — two much longer than the others, as we find them in Atractylis and Lafœa, — there are soon developed four additional tentacles; these

Fig. 274ª.

Fig. 275

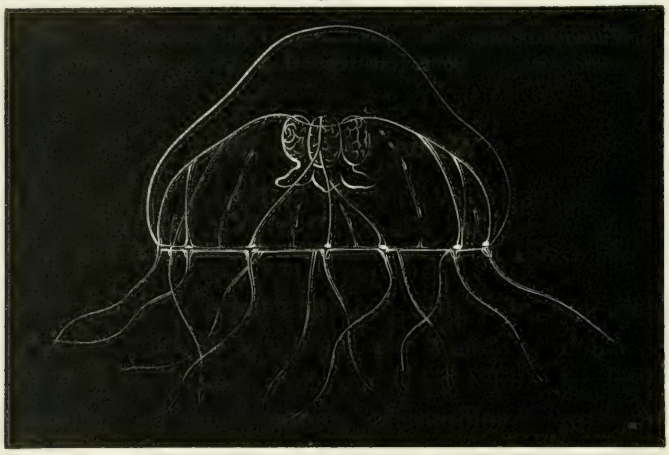
do not appear in the middle between the adjoining chymiferous tubes, but about one third of the distance. (Fig. 274ª.) When this second cycle of tentacles can be readily distinguished as four well-marked knobs along the circular tube, an offset branches off from the simple chymiferous tube, which soon extends to the circular tube, opposite the rudimentary tentacle; this offset takes its origin at two thirds the length of the chymiferous tube from the circular tube; at the same time this branch is forming, the main tube is slightly bent in the opposite direction from that in which the branch diverges; the offset

Fig. 274ª. Youngest Willia observed, having only the second set of tentacles developed. 2, second set of marginal tentacles; 2_c, branch of chymiferous tubes leading to them.

Fig. 275. A young Willia, nearly in the stage of Fig. 276, seen from the abactinal pole. 3, third set of tentacles; 3_c, chymiferous tube leading to them.

also is slightly convex, the convexity being turned towards the circular tube. The next cycle, the third, consists only of four tentacles, which all make their appearance on the other side of the main chymiferous tube, just as far on the other side as the tentacles of the second cycle were on this side of the main radiating tube; the offsets of the tube which reach these tentacles start slightly below the first, and

Fig. 276.



are likewise bent towards the circular tube. I was not able to observe the formation of the additional branches and tentacles. I refer this species at present to the *Willia ornata* of McCrady found at Charleston, the specimens which I found (Fig. 276) not being advanced enough to enable me to determine their difference or identity. The tubes which contain the clusters of lasso-cells (*l*, Fig. 279), running in the thickness

Fig. 277.

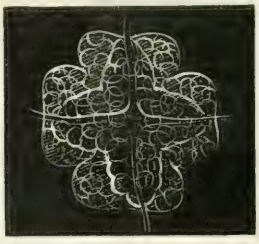


Fig. 278.

Fig. 279.

of the spherosome from the circular tube to the height of the base of the digestive cavity, were particularly well defined; the longer tubes, extending in the middle of the space between two chymiferous tubes, contain three clusters of lasso-cells, made up of from four to five large cells arranged in a circle. Even at this early stage the ovaries were well developed (Figs. 277, 278); they are elliptical bunches placed on

Fig. 276. Profile view of a young Willia; magnified.

Fig. 277. Part of the circular tube. *l*, tubes running into the thickness of the spherosome, containing large lasso-cells.

Fig. 278. View of ovary of Fig. 276.

Fig. 279. The same as Fig. 278, seen from the abactinal pole.

both sides of the cross-shaped edges of the digestive cavity, giving it a quadrangular appearance, when seen from above. (Fig. 279.) Found at Naushon the last part of September, one tenth to one eighth of an inch in diameter.

Charleston Harbor (McCrady); Buzzard's Bay, Naushon (A. Agassiz).

PROBOSCIDACTYLA Brandt.

Proboscidactyla Brandt; in Mém. Acad. St. Petersburg, II. p. 228. 1835.
Proboscidactyla Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1862.

Proboscidactyla differs from Willia in the mode of branching of the chymiferous tubes; in the former genus each main chymiferous tube divides into two halves, branching symmetrically on both sides from the two main branches, which is not the case in Willia.

Proboscidactyla flavicirrata Br.

Proboscidactyla flavicirrata Br.; in Mém. Acad. St. Petersb., p. 390, Pl. 19. 1838.
Proboscidactyla flavicirrata Agass. Cont. Nat. Hist. U. S., IV. p. 346. 1864.

This small Medusa seems quite uncommon in the Gulf of Georgia. I only found a couple of specimens, in the latter part of June, near Galiano Island. They are so small and so transparent that it requires the utmost attention to discover them. It seems to be the species found by Brandt on the coast of Kamtschatka; he was unable to find any actinostome in the trunk-like prolongation (Fig. 280), which he represents as surrounded by a large number of small tentacles; the digestive cavity opens by an actinostome, surrounded by four large lobes, and these subdivide into a number of smaller lobes, subordinate to the larger ones. (Fig. 281.) The ovaries are attached to the abactinal extremity of the chymiferous tubes, and extend but a short distance towards the periphery along the four radiating tubes (Fig. 281); the chymiferous tube runs single for a short distance, before the principal division into two branches takes place (*b*, Fig. 282); at the point of meeting of each of the smaller branches with the circular branch, there is a very marked eye-speck; the tentacles are numerous, each

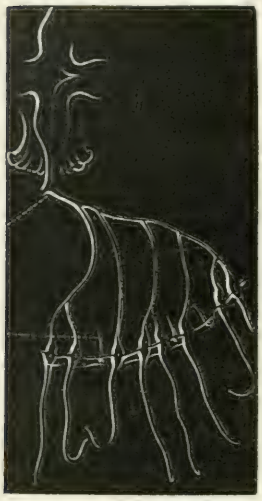
Fig. 280.

Fig. 281.

Fig. 280. Proboscidactyla flavicirrata; magnified.
Fig. 281. Actinostome and digestive cavity.

chymiferous tube dividing into two main branches, and each branch subdividing again into eight, making in all sixty-four branching tubes, and as many tentacles and eye-specks. Between each of the ocelli there extends from the circular tube a small tube penetrating into the thickness of the edge of the spherosome, which projects a considerable distance beyond the circular tube. The color of the digestive cavity is dirty yellow, the tentacles are of a brilliant straw color, and the ocelli dark blue. The whole exterior of the spherosome is densely granulated, the projections being probably something similar to what we find on the disk of *Aurelia flavidula*, made up of large lasso-cells, only much more densely crowded together. The shape of the bell is almost perfectly thimble-shaped, there being neither bulging nor striking indentations of the periphery. The motions of this Medusa are very rapid; the tentacles are capable of but little contraction.

Fig. 282.



Petropolawsky (Mertens); Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 62, Gulf of Georgia, W. T., June, 1859, A. Agassiz. Medusa.

Fig. 282. Portion of disk, to show the mode of branching. *b*, first fork; *l*, tubes containing lasso-cells, as in Willia.

Family SARSIADÆ Forbes.

Sarsiadæ Forbes (*restr.* Agass.). Brit. Naked-eyed Medusæ, p. 54. 1848.
Sarsiadæ Agass. Cont. Nat. Hist. U. S., IV. pp. 184, 217, 339. 1862.

CORYNE Gärt.

Coryne Gärt.; in Pall. Elen. Zooph. 1774. Hydra.
Syncoryna Ehrenb. (*p. p.*). Corall. des Rothen Meeres. 1834. Hydra.
Stipula Sars. Bidrag til Söedyr. Nat. 1829. Hydra.
Hermia Johnst. British Zoophytes, p. 111. 1838. Hydra.
Coryne Agass. Cont. Nat. Hist. U. S., IV. p. 339. 1862. Hydra.
Sarsia Less. Zooph. Acal., p. 333. 1843. Medusa.
Sthenio Duj.; in Ann. Sc. Nat. 1845. Medusa.
Sarsia Agass.; in Mem. Am. Acad., p. 224. 1849. Medusa.

Coryne mirabilis Agass.

Fig. 283.

Coryne mirabilis Agass. Cont. Nat. Hist. U. S., IV. pp. 185–217, Figs. 9–31; Pl. 20, Figs. 1–9; Pl. 23ᵃ, Fig. 12; III. Pl. 11ᶜ, Figs. 14, 15; Pls. 17–19. 1860–62.
Sarsia mirabilis Agass.; in Mem. Am. Acad., IV. p. 224, Pls. 4, 5.
Sarsia mirabilis Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Oceania tubulosa Gould (*non* Sars). Inv. of Mass., p. 348. 1841.
Sarsia glacialis Mörch; in Beskriv. af Groenland, p. 95. 1857.
Tubularia stellifera Couth.; in Bost. Journ. Nat. Hist., II. p. 56.
Tubularia stellifera Gould. Inv. Mass., p. 350. 1841.

This Medusa (Figs. 283, 284, 285) is one of the earliest visitants of our wharves. The ice has scarcely gone from the shores when numbers of young Medusæ, just freed from the Hydrarium, swarm near the surface on any sunny day. Captain Couthouy has described, under the name of *Tubularia stellifera*, a Hydroid which is probably the Hydroid of our *Sarsia mirabilis*; as the specimens from which his descriptions were made have not been pre-

Fig. 284.

Fig. 285.

Fig. 283. Adult Coryne mirabilis, seen in profile; one half natural size.

Fig. 284. Coryne mirabilis, with proboscis contracted. *t*, tentacles; *e*, veil; *c*, circular tube; *o*, actinostome.

Fig. 285. Coryne mirabilis, with expanded proboscis. *d*, proboscis; *a*, *b*, thickness of the bell.

served, I am unable to state this positively. It seems to make but little difference to the Hydrarium (Figs. 286, 287, 288) or to the

Fig. 286.

Fig. 288.

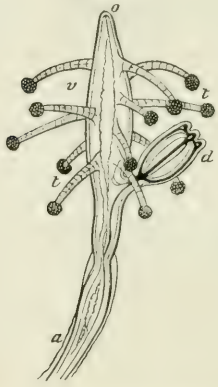


Fig. 287.

Medusa whether they live in pure sea water, such as they find at Nahant, or live in the more brackish waters of the inner harbor of Boston; they are equally abundant in both localities.

Massachusetts Bay (L. Agassiz).

Cat. No. 45, Nahant, Mass., May, 1862, A. Agassiz. Hydromedusarium.

Cat. No. 60, Nahant, May, 1862, H. J. Clark. Hydrarium.

Cat. No. 64, Nahant, March, 1862, H. J. Clark. Hydrarium.

Cat. No. 268, Boston, April, 1862, A. Agassiz. Young Medusæ.

Cat. No. 269, Boston, May, 1862, A. Agassiz. Young Medusæ.

Museum Diagrams, No. 20, 21, after L. Agassiz.

Coryne rosaria A. Agass.

Coryne rosaria A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 340. 1862.

I have but little doubt that the Hydroid here described is the larva of *Coryne rosaria;* this settles any doubt there may be concerning the specific differences between this Medusa, and the European or American representatives on the two sides of the Atlantic. The Hydrarium resembles somewhat *Coryne stipula* of Sars, but the proportions of the individuals of these two Hydraria are totally different; what is particularly characteristic of *Coryne stipula* is the stoutness and great size of the head and stem, compared to the size of the community; in *Coryne rosaria* the heads, which are quite slender, are supported by remarkably long and attenuated stems; they branch also very profusely, and it is not uncommon to find communities of this graceful Coryne reaching a height of three to three and a half inches. Medusæ buds were

Fig. 286. Cluster of Hydraria of Coryne mirabilis.
Fig. 287. Young Hydrarium.
Fig. 288. Magnified view of a head with Medusa bud, *d*, attached.

observed on the Hydrarium in March; no young Medusæ have been observed; the adults attain an enormous size, measuring more than an inch in polar diameter, as in Fig. 289, which is drawn the natural size.

Fig. 289.

The spherosome bulges very rapidly from the abactinal pole (Fig. 289) till it reaches the point of junction of the chymiferous tubes; from there it tapers very gradually towards the peripheric tube; the chymiferous tubes are exceedingly slender, the digestive cavity very long, projecting one half its length beyond the circular tube, swelling near the lower extremity, and then suddenly contracting, tapers gradually, in the form of a conical projection, beyond the ovaries; the sensitive bulbs are large, the eye-specks small. The proboscis and the tentacles are of a dirty-yellow color, the color of the swelling of the proboscis and of the sensitive bulbs being somewhat darker. It resembles *Sarsia tubulosa* of the English coast more than *Sarsia mirabilis* of New England. Found in the Straits of Rosario in May, and as late as the beginning of July in the Gulf of Georgia, W. T., and also in the harbor of San Francisco during November.

San Francisco, Cal. (A. Agassiz); Gulf of Georgia, W. T. (A. Agassiz).

Cat. No. 48, Gulf of Georgia, W. T., May, 1859, A. Agassiz. Medusa.

Cat. No. 49, San Francisco, Cal., March, 1860, A. Agassiz. Hydromedusarium.

SYNDICTYON A. Agass.

Syndictyon A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 340. 1862.

Syndictyon reticulatum A. Agass.

Syndictyon reticulatum A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 340. 1862.

The Hydrarium (Fig. 290) resembles that of *Coryne mirabilis;* it is much smaller, not being more than one tenth of an inch in height; it does not branch, or only occasionally once, near the base, in very old specimens. The stem is slender, the head large, club-shaped, the tentacles short, eight or ten in number. The Medusæ develop among the tentacles in the lower part of the head; this development is similar to that of Sarsia; when the Medusa is separated it is nearly as large as the whole Hydrarium, measuring about one sixteenth of an inch in

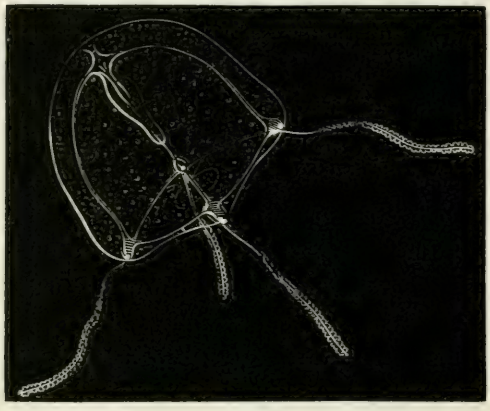
Fig. 289. Coryne rosaria, natural size.

diameter. The young Medusæ resemble somewhat Zanclea (Fig. 291), having the lasso-cells of the marginal tentacles arranged spirally in large clusters on the surface of the tentacles; the more advanced Medusæ lose this character. The bunches of lasso-cells increase in size towards the extremity, where the tentacle terminates in a club-shaped bunch (Fig. 292) larger than the others; the sensitive bulb is large, the

Fig. 292.

Fig. 290.

Fig. 291.



ocellus at the base of the tentacle (Fig. 293) is similar to that of Sarsia, the spherosome is of a uniform thickness, and the proboscis (Fig. 294) resembles somewhat that of Dipurena; the whole surface of the spherosome is covered with clusters of large lasso-cells (Fig. 296), giving it a granulated appearance; the ground-work consists of minute granulation, which appears under a low magnifying power to be arranged

Fig. 293.

Fig. 294.

Fig. 295.

Fig. 290. Hydromedusarium of Syndictyon reticulatum, greatly magnified.

Fig. 291. Syndictyon reticulatum, immediately after it has become freed from the Hydromedusarium; in profile, magnified.

Fig. 292. One of the tentacles of Fig. 291, magnified.

Fig. 293. Sensitive bulb of Fig. 291.

Fig. 294. Digestive cavity of Fig. 291.

Fig. 295. Fig. 291, from the actinal side.

in rows parallel to the circular tube, upon which are scattered large lasso-cells. The actinal and polar axes are of about the same length; the veil is well developed (Fig. 295); the central part of the spherosome is uniformly arched outside; the curve of the inner cavity is concentric with it; the proboscis extends somewhat more than half the length of the height of the cavity of the bell; the circular and chymiferous tubes are narrow (Fig. 296), of uniform diameter throughout; the sensitive bulb is ovoid, with a well-defined lenticular-shaped concentration of black pigment-cells (Fig. 293); the bulb itself is colored light-brown; the walls of the tentacles are thick, the tentacular tube tapering rapidly as it nears the extremity of the tentacle, where the walls increase in thickness in proportion as the tube diminishes in bore; the bunches of lasso-cells begin at some distance from the base of the tentacle (one fourth of the length of the tentacle), increase rapidly in size, being packed closer and closer towards the extremity of the tentacle, where they are large crescent-shaped masses, almost touching each other, and composed of very elongated lasso-cells. (See Fig. 292.) The tentacles are not very contractile; usually they are about as long as the vertical diameter of the bell, and I have seen them contracted to about half that length; the peduncle is not contractile. The large lasso-cells of the surface of the spherosome (Fig. 297) are round; they are usually scattered singly over the whole surface, while the fine granulation of the surface of the bell consists of long, narrow cells, dividing into smaller granules, which are small, undeveloped lasso-cells, forming a net-work over the surface of the spherosome; the lasso-cells are not as numerous near the abactinal pole as towards the margin of the bell, above the circular tube. The motions of the Medusa are similar to those of Sarsia, the bell, owing to its thinness, being, however, much more flexible. The bell has a very light metallic-blue tinge. The Hydroid was found growing on *Diphasia rosacea*. Young Medusæ, similar to those developed from the Hydroid, are found swimming freely about during June and July.

Fig. 296.

Fig. 297.

The young Medusa described above gradually loses the characters which distinguished it from Sarsia, and as it becomes more advanced, it resembles so closely Sarsia, that were it not for the invariable

Fig. 296. Fig. 291, from the abactinal pole.

Fig. 297. Part of net-work of the surface of the spherosome. *c*, large lasso-cells; *c'*, cluster of smaller ones.

presence of the light reddish-brown eye-specks, which become red in the adult, it would be difficult, without very close examination, to distinguish them apart. The tentacles of the adult (Fig. 298) are not as long as those of Sarsia; they are likewise capable of much greater contraction, being often carried in a club-shaped form, not longer than half the vertical axis of the bell. (Fig. 299.) The actinostome is also very different; the lips (four in number) are quite prominent (*a'*, Fig. 300), though often carried in trumpet fashion, at

Fig. 298.

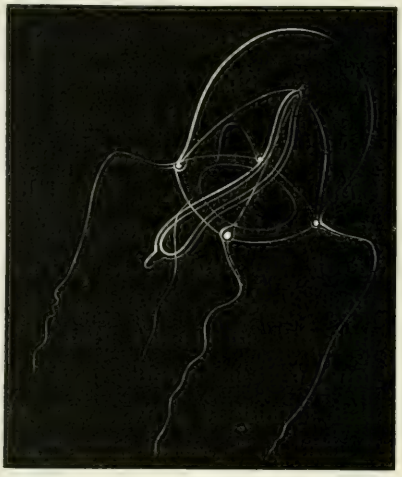


Fig. 299.

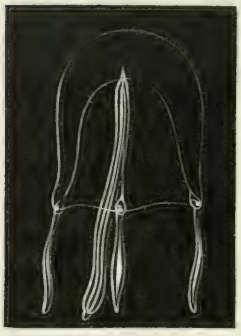


Fig. 300.

the extremity of the digestive cavity (*a*, Fig. 300), and the spherosome increases greatly in thickness at the abactinal pole.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 160, Nahant, Mass., July, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 348, Boston Harbor, May, 1862, H. J. Clark. Medusa.

Cat. No. 378, Nahant, 1863, A. Agassiz. Medusa.

DIPURENA McCr.

Dipurena McCr. Gymn. Charleston Harbor, p. 33.
Dipurena Agass. Cont. Nat. Hist. U. S., IV. p. 341. 1862.

McCrady established this genus from an investigation of two species of Medusæ, which, though having all the characteristics of Slabberia of Forbes, yet differed from it in the position of the sexual organs, which are placed in Dipurena along the digestive trunk, as in Sarsia and the like, while in Slabberia Forbes has figured genital organs along the

Fig. 298. Adult Medusa, in a natural attitude.

Fig. 299. The same Medusa as Fig. 298, with the tentacles contracted.

Fig. 300. Actinostome of adult Medusa. *a*, when protruded, trumpet-shape; *a'*, showing the lips of actinostome.

chymiferous tubes. This is so contrary to what we have thus far found to be uniformly the position of these organs among Tubularian Medusæ, that there is probably some mistake in Forbes's drawing.

Dipurena strangulata McCr.

Dipurena strangulata McCr. Gymnoph. of Charleston Harbor, p. 33, Pl. 9, Fig. 1.
Dipurena strangulata Agass. Cont. Nat. Hist. U. S., IV. p. 341. 1862.

Charleston, S. C. (McCrady).

Dipurena cervicata McCr.

Dipurena cervicata McCr. Gymn. Charleston Harbor, p. 34.
Dipurena cervicata Agass. Cont. Nat. Hist. U. S. IV. p. 341. 1862.

Charleston Harbor (McCrady).

Dipurena conica A. Agass.

Dipurena conica A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 341. 1862.

In the young Medusa the shape of the bell is nearly sugar-loaf (Fig. 301); the cavity of the bell is formed by a similar cone, with rounded apex; the disk diminishes rapidly in thickness towards the circular tube; the digestive cavity does not extend quite to the level of the veil; it is divided by a constriction into two unequal cavities, the upper one (*u*, Fig. 302) being about half the size of the lower one (*l*, Fig. 302); the walls of this cavity are thick, tapering gradually towards the actinostome, which is a simple opening, without labial appendages; the digestive cavity is scarcely contractile; the four marginal tentacles are short, the sensitive bulb is large, consisting of minute granular cells, the eye-speck being placed in a small button, standing out slightly from the base of the tentacle on the upper side (the abactinal side). (Fig. 303.) The walls of the tentacles are thick; they are made up of large elongated polygonal cells, giving the tentacles a striated appearance; the tube running through the tentacles is exceedingly fine, expanding slightly towards the extremity, where it joins the cavity of the terminal club; the large polygonal cells of the tentacle decrease in size towards the extremity, where there is a crescent-

Fig. 301.

Fig. 302.

Fig. 301. Young Dipurena conica; magnified.
Fig. 302. Digestive cavity of a young Dipurena conica. *u*, the upper part; *l*, the lower.

shaped row of large elliptical cells surrounding the upper end of the terminal cavity, these cells being surmounted by a thick coating of small granular cells, extending along the surface of the tentacle until they gradually disappear; these granular cells are pigment-cells, giving the terminal club a reddish tinge; the sensitive swelling at the base of the tentacles is colored by similar cells, the eye-spot being black.

Fig. 303.

This species differs from the *Dipurena strangulata* in the form of the bell, the proportions of the digestive cavity and of the terminal clubs of the tentacles, as well as the shape of the sensitive bulbs; according to McCrady, they are exceedingly pointed in *D. strangulata*, while the sensitive bulb of *D. conica* widens as it approaches the circular tube. The largest specimens taken were one sixth of an inch in diameter; smaller specimens, not more than an eighth of an inch, differed greatly from the more advanced. The bell is almost globular, of uniform thickness; the digestive cavity is short and rectangular in shape. As the young advance in age, the spherosome becomes more and more bell-shaped, and then conical; as the digestive trunk increases in length, it contracts near the base, and becomes pear-shaped towards the extremity. When still quite young, the first appearance of the constriction becomes visible; larger and older specimens, measuring one fourth of an inch, have a digestive cavity divided into two cavities, separated by a constriction, as in Fig. 304, where this separation has become quite prominent; when the Medusa is in violent motion, the proboscis will assume a quadrangular shape, with a large four-sided opening; this flexibility of the actinostome is lost in older specimens. In the oldest specimens which have been found (Fig. 305), the separation between the upper and lower part of the digestive trunk has become such, that the

Fig. 304.

Fig. 305.

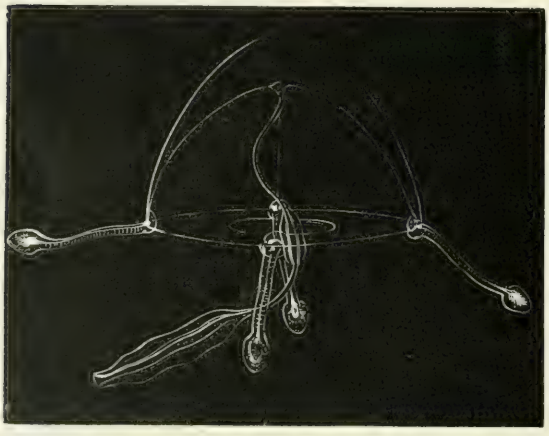


Fig. 303. Tentacle of Dipurena conica.

Fig. 304. Digestive cavity of a specimen in which the constriction has already separated the upper and lower halves.

Fig. 305. Adult Dipurena conica, in which the two digestive cavities are widely separated; greatly magnified.

two parts are simply connected by a narrow tube as long as the digestive cavities themselves; the narrow tube leading to the first digestive cavity extends to the level of the veil; the radiating tubes and the circular tube are thin, but there is no difference in the shape of the bell and of the tentacles of the different stages observed.

Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 439, Naushon, July, 1864, A. Agassiz.

Museum Diagram, No. 20, after A. Agassiz.

Family ORTHOCORYNIDÆ A. Agass.

I have ventured to separate the genus Zanclea from the Pennaridæ, with which it had been associated by McCrady and Professor Agassiz, and to form a new family, on account of the observations of Allman on the development of Zanclea from its Hydroid, *Coryne impressa* Ald. The peculiar form of the Hydrarium, and the still more remarkable characters of the Medusæ, with their tentacles bearing pedunculated knobs of lasso-cells, separate them from the square Medusæ of the Pennaridæ, while they remind us somewhat of the embryonic stages of Syndictyon. From the resemblance of this Hydroid to Halocharis and to Candelabrum, as well as owing to the close affinities of Corynitis to Zanclea, I would propose to unite all these forms into one family, the Orthocorynidæ. Does not also the *Heterocordyle Conybearei* belong to this family? The great difference between the reproductive and the sterile individuals is another example of the polymorphism so remarkable in Hydractinia.

CORYNITIS McCr.

Corynitis McCr. Gymn. Charl. Harbor, p. 29. Medusa.
Corynitis Agass. Cont. Nat. Hist. U. S., IV. p. 340. 1862.
Halocharis Agass. Cont. Nat. Hist. U. S., IV. p. 239. 1862. Hydrarium.

Corynitis Agassizii McCr.

Corynitis Agassizii McCr. Gymn. Charl. Harbor, p. 30, Pl. 9, Figs. 3–8.
Corynitis Agassizii Agass. Cont. Nat. Hist. U. S., IV. p. 340. 1862.
Halocharis spiralis Agass. Cont. Nat. Hist. U. S., IV. p. 239, Pl. 20, Figs. 10, 10ª. 1862.

Charleston, S. C. (McCrady).

GEMMARIA McCr.

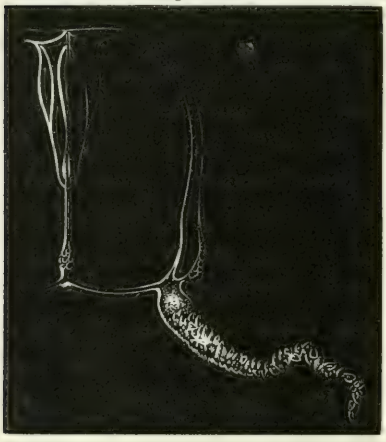
Gemmaria McCr. Gymn. Charl. Harbor, p. 49.
Zanclea McCr. (*non* Geg.). Gymn. Charl. Harbor, p. 48.
Zanclea Agass. (*p. p.*). Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Acrochordium Mey.; in Nov. Ac. N. Aur XVI. 1834. Hydrarium?

Gemmaria gemmosa McCr.

Gemmaria gemmosa McCr. Gymn. Charl. Harbor, p. 49, Pl. 8, Figs. 4, 5.
Zanclea gemmosa McCr. Gymn. Charl. Harbor, p. 49.
Zanclea gemmosa Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.

McCrady has distinguished with reason the genus Gemmaria from the Zanclea of Gegenbaur. The form of the bell of the digestive cavity and of the tentacles are totally different in the two genera. Very young specimens (Fig. 306) of this species, observed at Naushon, differed essentially from the *Gemmaria cladophora* of Massachusetts Bay, in the character of the tentacles and the shape of the clusters of lasso-cells; in the present species, the clusters of lasso-cells are attached by a short peduncle, and are arrow-shaped; the great tenuity of the bell in the specimen here figured is a characteristic of the younger stages, which disappears in older specimens. (See McCrady's figures.)

Fig. 306.



Charleston, S. C. (McCrady); Buzzard's Bay, Naushon (A. Agassiz).

Gemmaria cladophora A. Agass.

The shape of the inner bell of the adult Medusa of this species is peculiar; the outline does not follow that of the outer bell (Fig. 307),

Fig. 307.

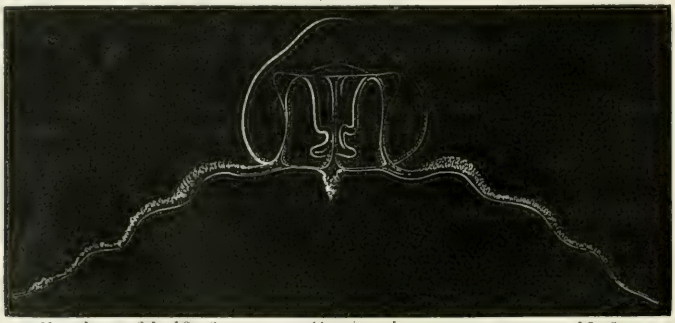


Fig. 306. Profile view of half of a young Gemmaria gemmosa; magnified.
Fig. 307. Profile view of Gemmaria cladophora; magnified.

but is curved in the opposite direction; near the upper bend of the chymiferous tubes, it runs up into a point, making a sharp and deep groove round the projection of the spherosome; the chymiferous tubes (c', Fig. 308), as well as the circular tube, are very broad (Fig. 308), opening into a conical digestive cavity, which at its base occupies nearly the whole width of the upper part of the inner bell; this cavity tapers gradually till it reaches the level of the veil, where the edges flare a little; the extremity of the proboscis has a tendency to be slightly drawn in, so that the opening of the cavity is flanked by the pouches formed by the partial contraction of a portion of the walls; the walls are thick, and open into a quadrangular mouth (Fig. 309), surrounded by a couple of concentric rows of large lasso-cells; similar large cells extend on the outside of the chymiferous tubes, more than half-way up the spherosome. (Fig. 308.)

Fig. 308.

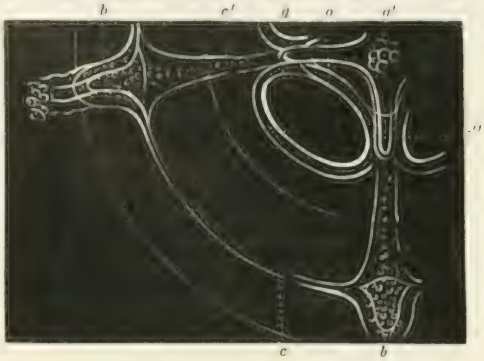


Fig. 309.

The tentacles are broad and thick, two of them being more developed than the others (Fig. 307); they are of a light-brown color, with orange pigment-cells at the base; the knobs of lasso-cells are attached to quite long stems (Fig. 310); the walls of the digestive cavity are thick; the ovaries are placed in the upper part of the proboscis. Found at Nahant in the beginning of August. When at rest, the tentacles are stretched out very obliquely from the bell, and they often remain perfectly motionless in this position; the Medusæ are quite rapid in their movements. (Fig. 307.)

Fig. 310.

Professor Clark discovered at Nahant a Hydroid closely resembling the *Coryne implexa* of Alder, and which I suspect will prove to be the nurse of our Gemmaria; this would be in accordance with the observations of Allman on the development of Zanclea from *Coryne implexa*.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 363, Nahant, 1862, A. Agassiz. Medusa.

? Cat. No. 63, Nahant, May, 1862, H. J. Clark. Hydrarium.

Museum Diagram, No. 20, after A. Agassiz.

Fig. 308. Quarter of the disk of G. cladophora, seen from the abactinal pole. c, circular tube; c', chymiferous tube; b, sensitive bulb, having a great accumulation of pigment and lasso cells extending along the chymiferous tubes; c'', opening leading into the chymiferous tubes from the digestive cavity, o; g, g, genital organs; g', fatty globules at base of proboscis.

Fig. 309. Actinostome of Gemmaria, enlarged.

Fig. 310. Cluster of lasso-cells of the marginal tentacles.

CANDELABRUM Blainv.

Candelabrum Blainv. Man. d'Actin., p. 307. 1834.
Candelabrum Agass. Cont. Nat. Hist. U. S., IV. p. 340. 1862.
Myriothela Sars. Reise i Lof. og Fin., p. 14.
Spadix Gosse; in Ann. & Mag. N. H., p. 125. 1855.

Candelabrum phrygium Blainv.

Candelabrum phrygium Blainv. Man. d'Actin., p. 317. 1834.
Lucernaria phrygia Fab. Fauna Grönlandica. No. 333.
Lucernaria phrygia Agass. Cont. Nat. Hist. U. S., IV. p. 341. 1862.
Corymorpha phrygia Mörch.; in Besk. af Grönland, p. 96.

Greenland (Fabricius); Grand Manan (W. Stimpson).

Cat. No. 161, Grand Manan, W. Stimpson. Hydromedusarium.

Family PENNARIDÆ McCr.

Pennaridæ McCr. (*restr.* A. Agass.). Gymn. Charl. Harbor, p. 46.
Pennaridæ Agass. (*p. p.*). Cont. Nat. Hist. U. S., IV. pp. 278, 344. 1862.

This family is restricted here to the single genus Pennaria, Zanclea having been removed from this family since the discovery of its development from a Coryne-like Hydrarium by Allman.

PENNARIA Goldf.

Pennaria Goldf. (*non* Oken). Handb. der Zoologie, p. 89. 1820.
Pennaria McCr. Gymn. Charl. Harbor, p. 50.
Pennaria Agass. Cont. Nat. Hist. U. S., IV. pp. 278, 344. 1862.
Globiceps Ayres; in Proc. Bost. Soc. Nat. Hist., IV. p. 193. 1852.
Globiceps Agass. Cont. Nat. Hist. U. S., IV. p. 344. 1862.
Eucoryne Leidy. Inv. N. J. and R. I., p. 4. 1855.

I have not given to the *Globiceps tiarella* of Ayres a new generic name, although it is probable that it does not belong to the same genus as the *Pennaria gibbosa* Agass., as the development of the latter species requires renewed examination to decide the question.

Pennaria gibbosa Agass.

Pennaria gibbosa Agass. Cont. Nat. Hist. U. S., IV. pp. 278, 344; III. Pl. 15, Figs. 1, 2.

Florida (L. Agassiz).

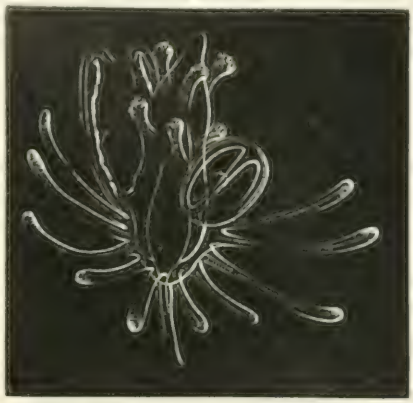
Cat. No. 19, Key West, Florida, March, 1853, L. Agassiz. Hydromedusarium.

Cat. No. 20, Jéremie, Hayti, Dr. Weinland.

Pennaria tiarella McCr.

Pennaria tiarella McCr. Gymn. Charleston Harbor, p. 51.
Globiceps tiarella Ayres; in Proc. Bost. Soc. Nat. Hist., p. 193, Pl. X. Figs. 1–5. 1852.
Eucoryne elegans Leidy. Mar. Inv. N. J. and R. I., p. 4. 1855.
Globiceps tiarella Agass. Cont. Nat. Hist. U. S., IV. p. 344 1862.

Fig. 311.



The Medusa of *Globiceps tiarella* is one of the most remarkable of our naked-eyed Medusæ. As in the Sarsiadæ, the Medusa bud is formed among the tentacles (Fig. 311), between the whirl of large and small tentacles; the mode of development of the bud is similar to that of Coryne and Bougainvillia; the chymiferous tubes, however, never have the extraordinary thickness which is noticed in Sarsia, and the cavity of the bell is hollowed out at an earlier period; the Medusa bud gradually becomes very elongated as it becomes more mature.

Fig. 312.

Large white eggs are developed from the proboscis, filling the whole cavity of the bell as they increase in size, and giving the Medusa an opaque milky appearance; the walls of the spherosome become thinner and thinner, and when the Medusa bud has attained its full development, and is ready to be separated, the walls have become so thin that the Medusæ are almost always distorted, either on one side or the other, by the eggs or bunches of spermaries which have reached such a great size that four or five of them completely fill the inner cavity, at the same time pressing the sides outward, wherever one of the large eggs happens to be placed (*e*, Fig. 312); two or three of the eggs generally escape before the Medusa bud is liberated, and when they are found detached, the cavity of the bells usually does not contain more than one or two large eggs; folds appear on the inner surface of the cavity of the bell after the eggs have escaped,

Fig. 313.

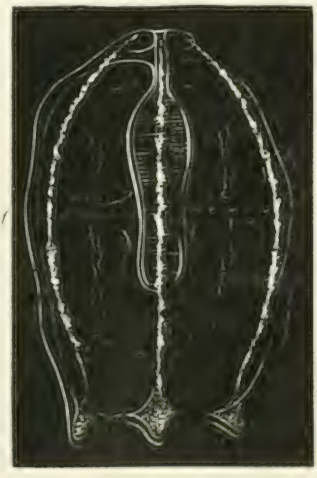


Fig. 311. A fertile Hydra of Pennaria tiarella, showing the mode of budding; magnified.
Fig. 312. A Medusa distended by an egg, *e*; magnified.
Fig. 313. Profile view of Medusa of Pennaria tiarella; magnified. *f*, folds produced by the distension of spherosome.

owing to their distension (*f*, Fig. 313); as soon as the eggs have all escaped, and the Medusæ have become detached, they move about with great activity, their motions resembling the quick, restless movements of Sarsia.

The size of the free Medusa is about one sixteenth of an inch; the walls of the spherosome are so thin that the Medusa will often assume a quadrangular or octagonal outline (Fig. 314), with deep indentations between the chymiferous tubes (Fig. 315); the digestive trunk is short, bottle-shaped, not extending more than half the length of the inner cavity of the bell; it is suspended by the narrow part (Fig. 313), the connection of the digestive cavity with the Hydrarium dividing the abactinal part of the bell in such a way that when seen in profile there are two circular masses above the chymiferous tubes. As the Medusa grows older, this open connection does not seem to diminish, as it does in the Sarsiadæ, Bougainvilleæ, and others. The chymiferous tubes,

Fig. 314.

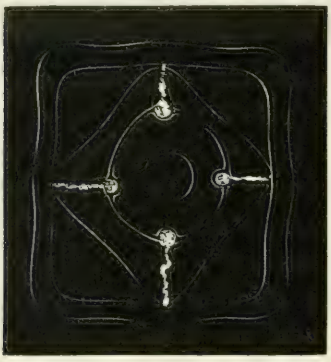


Fig. 315.

four in number, are broad, running almost perpendicularly, after making a sharp bend at the top, from the abactinal pole to the circular tube; there are also four well-developed sensitive bulbs; the tentacles on the contrary remain always in a rudimentary condition (Fig. 313), being simply four small knobs scarcely projecting beyond the general outline of the bell; the opening of the veil is small.

What becomes of the Medusa after the eggs have escaped, I am not able to say, though I am inclined to think that they do not undergo changes of any importance, as I have kept them in confinement for three weeks without noticing any striking differences. The color of the Medusa, when freed from its eggs, is of the most delicate rose color; the digestive trunk and the chymiferous tubes are a little darker, and a line of rich crimson pigment-cells, running almost their whole length, makes this Medusa one of the most brilliantly colored of our coast. Found at Naushon, during the month of September.

Buzzard's Bay (Ayres, A. Agassiz); Massachusetts Bay (A. Agassiz); New Jersey (Leidy); Charleston, S. C. (McCrady).

Fig. 314. A different attitude of the Medusa, seen from the actinal pole.
Fig. 315. Fig. 313, seen from the abactinal pole.

Cat. No. 21, Suisconset, Mass., July, 1849, L. Agassiz. Hydromedusarium.
Cat. No. 22, Naushon, Sept. 1861, A. Agassiz. Hydromedusarium.
Cat. No. 23, Newport, R. I., Prof. J. Leidy. Hydromedusarium.
Cat. No. 24, Newport, R. I., S. Powell. Hydromedusarium.
Cat. No. 25, Beverly, Mass., T. Lyman. Hydrarium.
Cat. No. 26, West Yarmouth, Mass., Aug. 1860, T. Lyman. Hydrarium.
Cat. No. 407, Nahant, September, 1862, A. Agassiz. Hydrarium.

Family TUBULARIADÆ Johnst.

Tubulariadæ Johnst. (*restr.* Agass.); in Trans. Berwick Club, p. 107.
Tubulariadæ Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.

EUPHYSA Forbes.

Euphysa Forbes. British Naked-eyed Medusæ, p. 71. 1848.
Euphysa Agass. Cont. Nat. Hist. U. S., IV. p. 343. 1862.

The outline of the bell of this genus is entirely different from that of Corymorpha or of Hybocodon. It can at once be recognized by its quadrangular shape, and the great thickness of the spherosome above the base of the digestive cavity, which is short and cylindrical. The tentacles also are always short and hollow, but are developed in the same proportion as in Corymorpha, — one stout triangular one, a pair somewhat less advanced, and an odd rudimentary one; the large tentacle never attains the size which it does in Hybocodon or in Corymorpha. The pigment bands at the base of the tentacles are quite short, and extend but little way along the chymiferous tubes. The ovaries are placed on the sides of the proboscis; the bell is symmetrical.

Euphysa virgulata A. Agass.

This Medusa attains a size of about half an inch; the polar diameter is nearly one third greater than the actinal (Fig. 316); the proboscis (Fig. 317) is short, not more than half the length of the inner bell (Fig. 316); the veil is slightly indented (Fig. 318); the tentacles (*t*, *t'*, Fig. 318) are triangular, and covered with large granules of a milky color, with a band of intensely pink pigment-cells extending a short distance (*p*, Fig. 319) along the chymiferous tubes, from the base of the tentacles; the proboscis is cylindrical, of a light yellow color, with a perfectly smooth actinostome, and fatty globules generally accumulated at the base (*g*, Fig. 317), as in Corymorpha and Hybocodon.

The Medusa is exceedingly active, moving very rapidly and incessantly. Found at Nahant in the latter part of August.

Fig. 316.

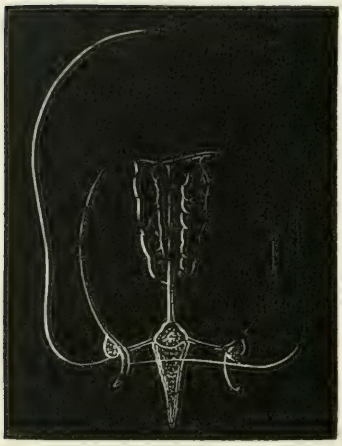


Fig. 317.

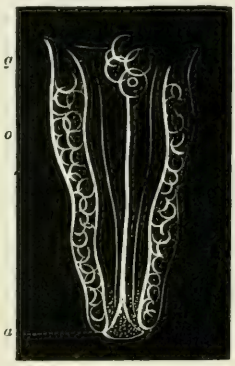
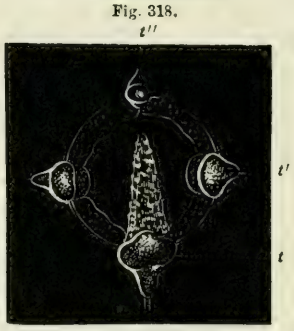


Fig. 319.

Fig. 318.



Euphysa is not, as Professor Agassiz has stated, the generation of Medusæ which become separated from the base of the reproducing tentacle in Hybocodon. That generation of Medusæ are identical with the parent Medusa, as well as the second generation which bud from the large tentacle of this first set of Medusæ.

Massachusetts Bay, Nahant (A. Agassiz).

Cat. No. 452, Nahant, A. Agassiz.

ECTOPLEURA Agass.

Ectopleura Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.

In this genus I would include those species of the genus Sarsia (like *Oceania telostyla* Geg., *Sarsia turricula* McCrady, and *Sarsia gemmifera* Forbes) which have a short digestive trunk, and in which the pigment-cells are not concentrated in one mass in the sensitive bulb, but are scattered irregularly through the whole swelling at the base of the tentacles.

Fig. 316. Euphysa virgulata, seen in profile; magnified.

Fig. 317. Proboscis of Euphysa. *a*, actinostome; *o*, ovaries; *g*, fatty globules; magnified.

Fig. 318. Actinal view of Euphysa, to show the character of the veil. *t*, the odd long tentacle; *t'*, one of the pair of tentacles; *t''*, the odd small tentacle.

Fig. 319. One of the tentacles seen in profile, to show the character of the band of pigment cells, *p*, extending along the base of the chymiferous tube from the origin of the tentacle, *t'*.

Ectopleura turricula Agass.

Ectopleura turricula Agass. Cont. Nat. Hist. U. S., IV. p. 343. 1862.
Sarsia turricula McCr. Gymn. Charleston Harbor, p. 36, Pl. 8, Figs. 6–8.

Charleston, S. C. (McCrady).

Ectopleura ochracea A. Agass.

Ectopleura ochracea A. Agass.; in Agassiz's Cont. Nat. Hist. U. S., IV. p. 343. 1862.

The bell is of uniform thickness from the circular tube as far as the base of the digestive cavity; here the outline tapers gradually towards the abactinal pole (Fig. 320), giving the upper part of the bell a much greater thickness, and a conical shape. Near the base of the digestive cavity there is a very marked constriction; it then bulges out towards the middle, contracting again towards the actinostome, which is simple; the opening is formed by the abrupt termination of the walls of the digestive cavity; there are no labial appendages of any sort, except small bunches of lasso-cells. The tentacles are short; when swimming about they are usually carried tightly curled up near the circular tube. This species differs from the *S. turricula* McCr. in having the surface of the tentacles covered irregularly with innumerable lasso-cells; they are not arranged in bundles, as in the Charleston species. From each side of the base of the four tentacles there runs to the abactinal pole (Figs. 321, 322) a thread of bunches of lasso-cells (*l*, Fig. 320), like that of Turritopsis. The bunches are large near the actinal extremity, and gradually diminish to the abactinal pole, where there is only one cell, while near the base of the tentacles the bundles are made up of aggregations of clusters of lasso-cells, consisting of two or three cells each. An accumulation of bright yellow pigment-cells forms a ring round the point of attachment of the digestive trunk; the digestive cavity itself is of a delicate rose color, with whitish bunches of lasso-cells at the actinostome, surmounted by a second light yellow ring immediately above it; the tentacles are of the color of the digestive trunk, but of a

Fig. 320

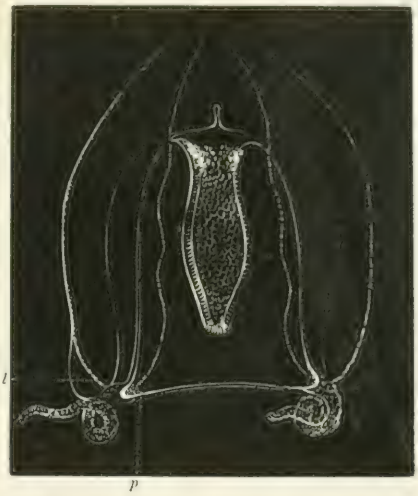
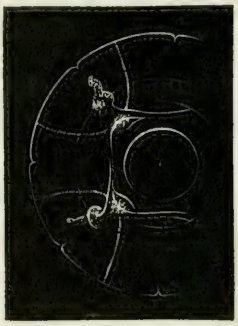


Fig. 320. Profile of Ectopleura ochracea, magnified. *l*, thread of lasso-cells extending to abactinal pole; *p*, pigment-cells at base of tentacles.

lighter tint; the pigment-cells in the sensitive bulb (*p*, Figs. 320, 323) are purplish-orange upon a light-yellow ground. When the Medusæ

Fig. 321.

Fig. 322



move about, which they do with great rapidity, the tentacles are twisted in knots, as stated above, but when at rest expand at right angles to the disk, and then the Medusa will often remain, balancing itself upon its tentacles, perfectly motionless in the water, appearing like a rosy tube, with its yellow ring set in a rectangle of four brilliantly colored ocelli.

Fig. 323.

Found at Naushon in September, the largest specimen being one fourth of an inch in diameter; young specimens have a shorter digestive trunk, and the rows of lasso-cells extending along the outer surface of the bell are more marked than in older specimens. The Hydroid of this Medusa probably resembles the *Tubularia Dumortierii* Van Beneden, the Medusa of which is closely allied to the one found on our coast.

Buzzard's Bay, Naushon (A. Agassiz).

Cat. No. 441, Naushon, Mass., A. Agassiz. Medusa.

CORYMORPHA Sars.

Corymorpha Sars. Beskriv., p. 6. 1835.
Corymorpha Agass. Cont. Nat. Hist. U. S., IV. p. 343. 1862.

Corymorpha pendula Agass.

Corymorpha pendula Agass. Cont. Nat. Hist. U. S., IV. pp. 276, 343, Pl. 26, Figs. 7–17.
Corymorpha nutans Stimps. Mar. Inv. Grand Manan, p. 9. 1853.
Corymorpha pendula A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 101, Fig. 31.

The Medusa of Corymorpha is, like Hybocodon, asymmetrical; the shape of the bell is more elongated (Fig. 324) and the tentacles more

Fig. 321. Fig. 320, seen from abactinal pole, to show the termination of the lasso threads.
Fig. 322. Fig. 320, seen from the actinal pole, showing the origin of the threads on each side of the base of the tentacles.
Fig. 323. The base of one of the tentacles, magnified. *p*, cluster of pigment-cells.

developed, the long tentacle (Fig. 324) attaining a size two or three times the length of the bell; the proboscis is long, and stretches beyond the aperture of the veil; the long tentacles (1, 2, Fig. 324) are capable of great contraction and expansion; the lasso-cells are arranged in groups upon them in such a manner as to appear like heavy rings surrounding the thinner thread; the outer wall of the proboscis is exceedingly thick, as in the Medusa of Euphysa, and of a light-yellow color; the pigment-cells at the base of the tentacles are light pink. This Medusa attains a size of a quarter of an inch, and is found at Nahant in the middle of May.

Fig. 324.

Although the separation of this Medusa from its Hydrarium has not been observed, yet their similarity to the most advanced Medusæ buds observed on our Corymorpha leave but little doubt on this point. Hodge has observed the development of an English species of Corymorpha, which resembles the Medusa here figured. (Fig. 324.)

Massachusetts Bay, Nahant (L. Agassiz).

Cat. No. 18, off Race Point, Cape Cod, Mass., March, 1862, A. S. Bickmore. Hydromedusarium.

Museum Diagram, No. 24, after L. Agassiz.

HYBOCODON Agass.

Hybocodon Agass. Cont. Nat. Hist. U. S., IV. p. 343. 1862.

Hybocodon prolifer Agass.

Hybocodon prolifer Agass. Cont. Nat. Hist. U. S., IV. pp. 243, 343, Pl. 23[a], Figs. 10, 11: Pl. 25. 1862.

This is one of the few known Tubularians found growing singly. (Fig. 325.) The character of the Medusæ is particularly important in a morphological point of view, giving us, as it does, the clew to the probable character of the scales (Deckstück) of the Nanomia, described below. The asymmetrical character of the Medusa (Figs. 326, 327) is more marked than in the Medusa of Corymorpha. The budding of Medusæ (Fig. 328), similar to the parent

Fig. 325.

Fig. 324. Medusa of Corymorpha, seen in profile. 1, long odd tentacle; 2, pair of tentacles, 3, short odd tentacle.

Fig. 325. Single Hydra of Hybocodon. *o*, mouth surrounded with tentacles; *t*, *t*, marginal tentacles; *d*, *d*, advanced Medusæ buds; *a*, stem.

Medusa, from the base of the single largely-developed tentacle, is a feature it has in common with other Medusæ which have been referred by various writers to the genera Sarsia and Steenstrupia, and which very probably are all derived from a Tubularian nurse similar to Hybocodon. Should the Diplonema of Greene prove to be one of these asymmetrical Medusæ, the name Hybocodon must give way to that of Diplonema.

Fig. 326.

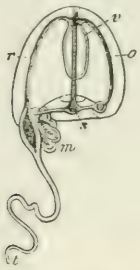
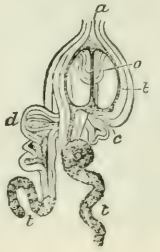


Fig. 327.

Fig. 328.



Massachusetts Bay (L. Agassiz).

Cat. No. 61, Nahant, Mass., May, 1862, H. J. Clark. Hydrarium.

Museum Diagram, No. 23, after L. Agassiz.

PARYPHA Agass.

Parypha Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.
Pyxidium Leuck.; in Archiv f. Nat., I. p. 31. 1856.

Parypha cristata Agass.

Parypha cristata Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.
Tubularia cristata McCr. Gymn. Charleston Harbor, p. 54.

Charleston, S. C. (McCrady).

Cat. No. 14, Sullivan's Islands, S. C., December, 1851, L. Agassiz.

? Cat. No. 16, Florida, 1850, L. Agassiz.

Fig. 326. Hybocodon prolifer Agass., seen from the broad side. *v*, proboscis; *r*, *o*, radiating tubes; *s*, circular tube; *m*, buds of Medusæ at base of long tentacle, *t*.

Fig. 327. Hybocodon prolifer, seen facing the long tentacle. *a*, point of attachment to Hydrarium; *b*, *c*, radiating tubes; *e*, rows of lasso-cells extending from base of tentacle to abactinal pole; *o*, proboscis; *f*, Medusæ budding from base of long tentacle, *t*.

Fig. 328. Medusa bud of Hybocodon. *a*, base of attachment; *o*, proboscis; *b*, *c*, chymiferous tubes; *d* and near *c*, Medusæ buds at base of tentacle, *t*.

Parypha crocea Agass.

Parypha crocea Agass. Cont. Nat. Hist. U. S., IV. pp. 249, 342, Pls. 23, 23², Figs. 1–7. 1862.

Boston Bay (L. Agassiz).

Cat. No. 13, Warren Bridge, Boston, June, 1858, H. J. Clark. Hydromedusarium.

Parypha microcephala A. Agass.

Resembles in its general aspect the *Parypha cristata* Agass.; the stem is more slender than that of *P. crocea*, found in Boston Harbor; the head is much smaller than in either of the above-mentioned species, though the stem grows to a size fully as great as in our Eastern Parypha, giving it a very characteristic aspect. Found attached to floating logs round the wharves of San Francisco.

San Francisco, Cal. (A. Agassiz).

Cat. No. 15, San Francisco, Cal., October, 1859, A. Agassiz. Hydromedusarium.

Cat. No. 17, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.

THAMNOCNIDIA Agass.

Thamnocnidia Agass. Cont. Nat. Hist. U. S., IV p. 342. 1862.

Thamnocnidia spectabilis Agass.

Thamnocnidia spectabilis Agass. Cont. Nat. Hist. U. S., IV. pp. 271, 342, Pl. 22, Figs. 1–20. 1862.

Massachusetts Bay, Boston (L. Agassiz).

Cat. No. 6, Boston, August, 1851, H. J. Clark. Hydromedusarium.

Thamnocnidia tenella Agass.

Thamnocnidia tenella Agass. Cont. Nat. Hist. U. S., IV. pp. 275, 342, Pl. 22, Figs. 21–30. 1862.

Massachusetts Bay, Nahant (L. Agassiz).

Cat. No. 7, Nahant, Mass., September, 1854, H. J. Clark. Hydromedusarium.

Cat. No. 8, Nahant, July, 1861, A. Agassiz. Hydromedusarium.

Cat. No. 410, Eastport, Me., 1861, Anticosti Expedition.

Cat. No. 411, Eastport, Me., 1863, A. E. Verrill.

Cat. No. 412, Eastport, Me., 1863, A. E. Verrill.

Thamnocnidia tubularoides A. Agass.

This species grows in clusters, which at first sight would readily be mistaken for a species of true Tubularia, on account of the great diameter of the stem, and the large size of the head. The structure of the proboscis, however, shows plainly that it is a genuine Thamnocnidia, which can at once be distinguished from its Eastern congeners by the stoutness of the stem and size of the head, surrounded by as many as from thirty and even forty tentacles in large specimens. Found growing profusely on the bottom of the coal-barges which bring coal from Benicia to the Pacific Mail Steamship Company's steamers at San Francisco.

San Francisco, Cal. (A. Agassiz).

Cat. No. 11, San Francisco, Cal., December, 1859, A. Agassiz. Hydromedusarium.

TUBULARIA Linn.

Tubularia Linn. (*restr.* Agass.). Syst. Nat. 1756.
Tubularia Agass. Cont. Nat. Hist. U. S., IV. p. 342. 1862.

Tubularia larynx Linn.

Tubularia larynx Ellis. Cor., Pl. 16, Fig. 6.
Tubularia larynx Johnst. Brit. Zooph., p. 50, Pl. 3, Fig. 3; Pl. 5, Figs. 3, 4.
Tubularia larynx Stimps. Mar. Inv. Grand Manan, p. 9. 1853.

Grand Manan (W. Stimpson).

Tubularia Couthouyi Agass.

Tubularia Couthouyi Agass. Cont. Nat. Hist. U. S., IV. pp. 266, 342, Pl. 23[a], Figs. 8, 9; Pls. 24, 26, Figs. 1–6. 1862.
Tubularia indivisa Stimps. Mar. Inv. Grand Manan, p. 9. 1853.
Tubularia indivisa Gould. Rep. Inv. Mass., p. 350. 1841.
Tubularia indivisa Mörch; in Besk. af Grönland, p. 96. 1857.

Massachusetts Bay (L. Agassiz).

Cat. No. 4, Boston, August, 1851, H. J. Clark. Hydromedusarium.

Cat. No. 5, Grand Manan, 1857, J. E. Mills. Hydromedusarium.

Museum Diagram, No. 24, after L. Agassiz.

Family HYDRAIDÆ Gray.

Hydraidæ Gray. Syn. Brit. Mus., p. 76. 1840.
Hydrina Ehrenb. (*p. p.*). Corall. d. Roth. Meeres, p. 67.
Hydraidæ Johnst. Brit. Zooph., p. 120, Second Edition.

HYDRA Linn.

Hydra Linn. Syst. Nat. 1756.

Hydra gracilis Agass.

Hydra gracilis Agass.; in Proc. Bost. Soc. Nat. Hist., III. p. 354.
Hydra gracilis Ayres; in Proc. Bost. Soc. Nat. Hist., V. p. 103.

Our fresh-water Hydra has as yet been studied so insufficiently, that I am unable to add anything respecting the development of the Medusæ, or concerning its identity with the European *Hydra viridis*. Agassiz has described two Eastern species under the name of *Hydra gracilis* and *H. carnea*, and Ayres a California species. From the character of the Medusæ of the Hydra, it seems to me that it finds its natural place among the true Hydroids, and not among the Discophoræ, with which it has usually been associated, on account of its close resemblance to the Scyphistoma (*Hydra tuba*).

Cambridge (L. Agassiz).

Cat. No. 370, Cambridge, 1862, W. Glen.

Hydra carnea Agass.

Hydra carnea Agass.; in Proc. Bost. Soc. Nat. Hist., III. p. 354.
Hydra carnea Ayres; in Proc. Bost. Soc. Nat. Hist., V. p. 104.

Massachusetts and Connecticut (Agassiz; Ayres).

Hydra tenuis Ayres.

Hydra tenuis Ayres; in Proc. Bost. Soc. Nat. Hist., V. p. 104.

San Francisco, California (Ayres).

Family HYDRACTINIDÆ Agass.

Hydractinidæ Agass. Cont. Nat. Hist. U. S., IV. p. 339. 1862.

HYDRACTINIA Van Beneden.

Hydractinia Van Beneden; in Bull. Acad. Bel., VIII. 1841.
Hydractinia Agass. Cont. Nat. Hist. U. S., IV. p. 339. 1862.
Synhydra Quat.; in Ann. des Scien. Nat., XX. p. 230. 1843.

Hydractinia polyclina Agass.

Hydractinia polyclina Agass. Cont. Nat. Hist. U. S., III. Pl. 16; IV. pp. 227–239, 339, Figs. 33–35; Pl. 26, Fig. 18. 1862.
Hydra squamata Fab. Fauna Grönlandica. No. 338.
Alcyonium echinatum Gould. Rep. Inv. Mass., p. 351.
Hydractinia echinata Leidy. Mar. Inv. New Jersey and Rhode Island, p. 3, Pl. X. Fig. 35. 1855.
Hydractinia echinata Stimps. Mar. Inv. Grand Manan, p. 11. 1853.
Hydractinia echinata McCr. Gymn. Charleston Harbor, p. 66.
Clava squamata Mörch; in Beskriv. af Grönland, p. 96.
Hydractinia polyclina Pack.; in Can. Nat. & Geol. Dec. 1863.

As such constant reference is made to Hydractinia in the comparison of the free colonies of Nanomia to the fixed Hydroids, figures of male

Fig. 329.

Fig. 330.

(Fig. 329) and female (Fig. 330) colonies of this species are here introduced to facilitate the comparison.

Point Judith (Leidy); Atlantic coast of North America (L. Agassiz).
Cat. No. 55, Grand Manan, 1859, A. E. Verrill.
Cat. No. 56, Grand Manan, October, 1857, J. E. Mills.
Cat. No. 57, Chelsea Beach, L. Agassiz.
Cat. No. 58, Swampscott, Mass., March, 1859, S. Tufts.
Cat. No. 59, Nantucket Shoals, July, 1849, L. Agassiz.
Cat. No. 403, Nahant, Mass., July, 1862, A. Agassiz.
Museum Diagram, No. 25, after L. Agassiz.

Fig. 329. Part of male community of Hydractinia. *a*, *a*, sterile individuals; *b*, fertile individual; *d*, male Medusæ; *o*, *o*, proboscis; *t*, elongated tentacle of sterile individuals.

Fig. 330. Part of female community. *a*, sterile individual; *b*, fertile individual, producing female Medusæ, *d*, *e*, *f*, *g*, *h*, *i*; *o*, peduncle of mouth; *c*, individual with globular tentacles.

Suborder DIPHYÆ Cuv.

Diphyæ Cuv. Règne Animal, IV. 1817.
Calycophoridæ Leuck. (*p. p.*); in Archiv f. Nat., I. p. 256. 1854.
Diphyæ Agass. Cont. Nat. Hist. U. S., IV. p. 370. 1862.

For the reasons which have led me to adopt the old divisions of Eschscholtz, and not the divisions of Leuckart, which have found such universal approval, I would refer to the description of Nanomia given below.

Family DIPHYIDÆ Esch.

Diphyidæ Esch. (*restr.* Agass.). Syst. der Acal., p. 122. 1829.
Diphyidæ Agass. Cont. Nat. Hist. U. S., IV. p. 371. 1862.

EUDOXIA Esch.

Eudoxia Esch. Syst. der Acal., p. 125. 1829.
Eudoxia Less. Zooph. Acal., p. 460. 1843.

Eudoxia alata McCr.

Eudoxia alata McCr. Gymnoph. Charleston Harbor, p. 70, Pl. 8, Figs. 9, 10.

Charleston Harbor (McCrady).

DIPHYES Cuv.

Diphyes Cuv. Règne Animal, IV. 1817.
Ersœa Esch. Syst. der Acal., p. 127. 1829.
Cucullus Q. & G.; in Ann. des Sc. Nat., X. 1829.
Diphyes Less. Zooph. Acal., p. 438. 1843.

Diphyes pusilla McCr.

Diphyes pusilla McCr. Gymn. Charleston Harbor, p. 72.

Charleston, S. C. (McCrady).

Suborder PHYSOPHORÆ Goldf.

Physophoræ Goldf. Handb. d. Zool. 1820.
Physophoræ Agass. Cont. Nat. Hist. U. S., IV. p. 367. 1862.

Family AGALMIDÆ Brandt.

Agalmidæ Brandt; in Mém. Acad. St. Petersburg, p. 234. 1838.
Agalmæ Less. Zooph. Acal., p. 509. 1843.
Stephanomiæ Less. Zooph. Acal., p. 475. 1843.
Stephanomidæ Leuck.; in Archiv f. Nat., I. p. 312. 1854.
Stephanomidæ Huxl. Ocean. Hyd., p. 72. 1858.
Agalmidæ Agass. Cont. Nat. Hist. U. S., IV. p. 368. 1862.

NANOMIA A. Agass.

Nanomia A. Agass.; in Proc. Boston Soc. Nat. Hist., IX. p. 181. 1863.

Nanomia cara A. Agass.

Nanomia cara A. Agass.; in Proc. Bost. Soc. Nat. Hist., IX. p. 181. 1863.

This Siphonophore is closely allied to the genus Agalmopsis of Sars, but the nature of the tentacles of the feeding polyps, and the mode of arrangement of the swimming-bells, show undoubtedly that it cannot be placed in the same genus as Agalmopsis, though closely related to it, as also to Halistemma of Huxley. The small size of this species has been of great advantage in enabling us to seize readily, at one glance, the connection between the different parts of this community, while the great size of many of the species hitherto observed has always been more or less of a drawback in analyzing the relations of the individuals of the community.

Fig. 331.

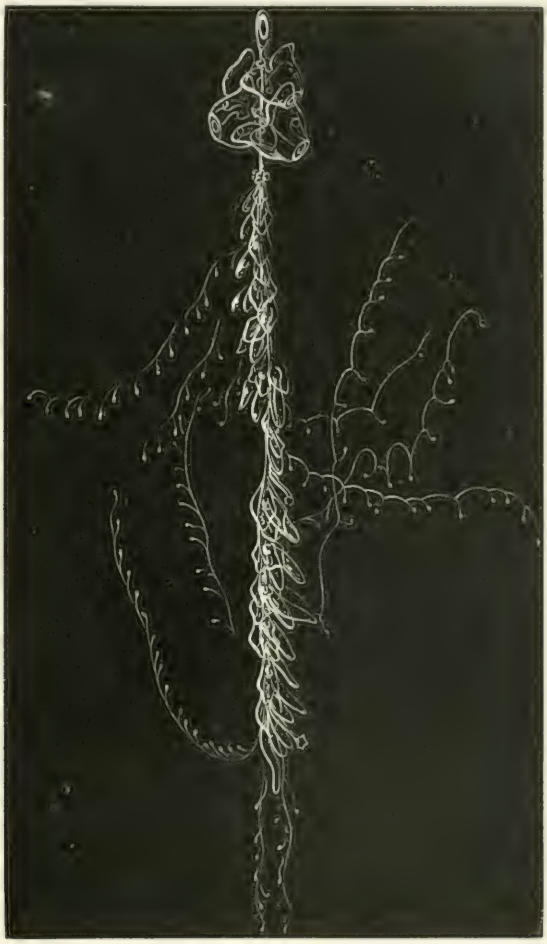
The float, or swimming-bladder, (I shall use at present the nomenclature usually adopted, and afterwards show to what parts these organs correspond in an ordinary Hydroid,) is a large elliptical cavity (Fig. 331), entirely shut off from the main cavity, which runs from the base of the float, through the whole of the axis of the community. It contains in this genus a bubble of oily substance; the nature of the contents of the float varies in different families of Siphonophoræ, and this cavity may or may not be closed. In this genus it is closed, and there is no access to the oil-bubble from without; the oil-bubble by no means fills the whole of the cavity of the float. The float is of a brilliant garnet color; from it hangs the rosy-

Fig. 331. Oil-float of Nanomia; magnified.

colored axis, with its pale swimming-bells, and farther down, the scales, protecting the different kinds of feeding polyps, with their various kinds of tentacles projecting in all sorts of angles and curves from the main axis of the body, like the festoons of a chandelier; the darker-colored polyps, tipped and mottled with scarlet, being visible underneath the protecting scales. (Fig. 332.)

The swimming-bells are arranged in two vertical rows, consisting of four to six large bells each; they are placed obliquely, in such a way

Fig. 332.



that the wing-like projections of the spherosome encroach upon those of the opposite row, and thus fit closely and compactly together, by a sort of oblique dovetail arrangement; these bells are only symmetrical when seen from one of the sides (Fig. 333), when they appear somewhat heart-shaped, having a large cavity which opens externally by means of an aperture (see Fig. 334) in a veil, similar to that of genuine naked-eyed Medusæ, and capable, like it, of beating up and

Fig. 332. Nanomia cara; natural size.

down, and forcing the water in or out of the cavity of the bell. From the abactinal pole of this cavity diverge four chymiferous tubes, which lead into a circular tube, connecting them all (*c*, Fig. 334); two of these tubes, *t'*, *t'*, are straight, and run directly from the point of junction of the four tubes (*j*, Fig. 334) to the circular tube, while the other tubes, *t*, *t*, wind round before joining the circular tube. The connection of these chymiferous tubes with the tube into which they run, and which connects them all with the main cavity of the axis of the community, can readily be traced by combining the different views of the swimming-bell here given. (Figs. 333–336.) In Fig. 333 the straight chymiferous tubes run perpendicularly to the circular tube, in continuation of the tube passing through the abactinal pole of the spherosome; while in Fig. 336, which is a view at right angles to that of Fig. 333, we see the connection of the winding tubes with the connecting tube; the opening (*j'*, Fig. 335) of the connecting tube (*t''*, Fig. 335) is somewhat to one side of the point of junction of the chymiferous tubes

Fig. 333.

Fig. 334.

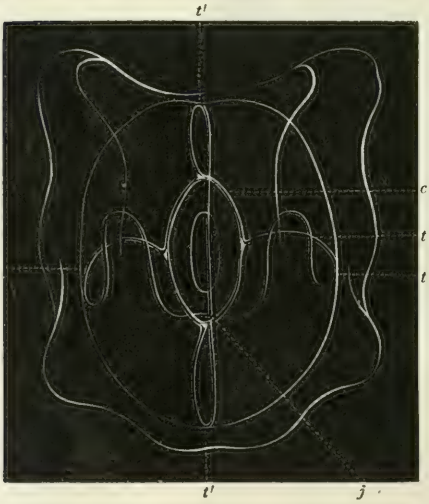
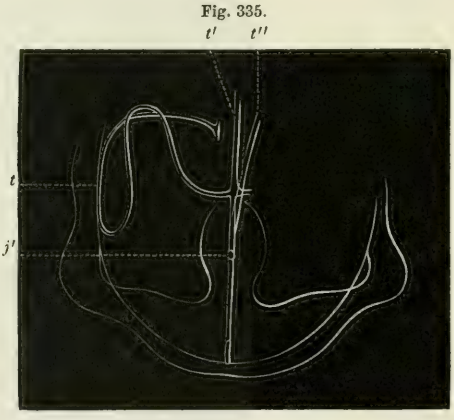


Fig. 335.



(*j*, Fig. 334), as is readily seen on examining Figs. 335, 336. Fig. 336 shows the wing-like expansions of the spherosome which clasp the axis, giving the Medusa a conical appearance, when seen from that side; while when seen from the actinal or abactinal pole, as Figs. 334, 335,

Fig. 333. Swimming bell of Nanomia, seen facing the side of the straight chymiferous tubes.

Fig. 334. The same bell, seen from the actinal pole, somewhat more magnified. *t*, *t*, bent chymiferous tubes; *t'*, *t'*, straight chymiferous tubes; *c*, circular tube round veil; *j*, point of junction of the four chymiferous tubes.

Fig. 335. A portion of the same bell, seen from the abactinal pole; lettering as in Fig. 334. *j'*, opening of tube, *t''*, leading into the main axis connecting with one of the straight chymiferous tubes.

the shape of the swimming-bell is rectangular. There can be but little doubt that these swimming-bells, as I have called them, are genuine Medusæ; they have all the characters of Medusæ, and when they become detached, move like them, the only difference being the absence of a proboscis to admit food. This, however, they do not need as long as they remain connected with the main axis, the cavity of which opens directly into the chymiferous tubes, and thus circulates in them whatever food is taken in at the feeding mouths, and from them passed into the cavity of the main axis. I have not been able to detect any opening leading directly into the system of chymiferous tubes. These Medusæ are the locomotive organs of the community; they force the water in and out of their cavity, and thus propel the whole community by a sort of alternating motion, resembling that of sculling a boat; the bells on one side of the axis are filling with water, while those of the other side are forcing the water out violently; the motion begins at the bottom bell, passes on to the top one of the same side, then begins at the bottom of the other row, and so on, throwing the whole of the upper part of the community violently from one side to the other, while the remainder is dragging lazily after it. I have not found any specimens with more than eight swimming-bells fully developed; the younger bells are added between the first-formed pair and the float, where we find a cluster of swimming bells in different stages of development. These young bells are formed, as the Medusæ buds of the Tubularians, by folds of the outer wall, which gradually grow larger and larger, and circumscribe parts of the main cavity to form chymiferous tubes.

Fig. 336.

In their younger stages, the swimming-bells resemble still more the Medusæ of Hydroids, when they have not yet assumed an irregular outline, and while their chymiferous tubes are still straight. In the cluster of young bells here given (Fig. 337), we find a few of the different stages through which one of these bells passes, from the time it appears as a mere bud, till it has gone through

Fig. 337.

Fig. 336. The same bell as Fig. 333, seen from the other side, to show the course of the bent tubes, and the mode of connection of the tubes leading into the main axis; *t*, bent tube.

Fig. 337. Group of swimming bells, in different stages of development. *a*, the chymiferous tubes are simple sacs; *b*, the tubes, having united, make a circuit; *c*, first signs of bending of the tubes, *t*, of the preceding figures.

the different phases in which the chymiferous tubes are mere pouches (*a*, Fig. 337), then large tubes connected by a circular tube (*b*, Fig. 337), till finally the bell becomes somewhat expanded at one pole, and the tubes have a tendency to bend, as in *c*, Fig. 337, when the difference between the two kinds of chymiferous tubes is quite marked, although the mode of attachment of the Medusa and the shape of the bell remind us strongly of Tubularian Medusæ buds, and we find no trace as yet of the wing-shaped appendages, and of the difference of outline of older Medusæ, when seen from different sides.

As there is a portion of the axis, immediately beneath the float, which is free from swimming-bells, we find also under the swimming-bells a small part of the axis bare; we soon, however, come upon a cluster of small buds entirely different in character from those found under the float; these are polyps, or feeding-mouths, in different stages of development. The polyps (Medusæ) to which this set of buds give rise are of very different characters; they are of three kinds, and nearly equally distributed along the remainder of the axis, no part of the axis being reserved for any special kind of polyps; the most prominent kind, and the largest, are the Hydra-mouths (Fig. 338), which are the most active, and in which we find, at the point of junction with the axis, a cluster of long tentacles, along the thread of which are fastened, by a short handle, a knob-like appendage; these are the tentacles which are so prominent, and assume such manifold attitudes when the community is at rest or in motion. The polyps are open at the distal extremity, the opening being frequently expanded like the disk of a leech, or simply flaring trumpet-shaped; they are exceedingly contractile, and sometimes expand far beyond the axis in search of food; they communicate by means of a somewhat narrow neck with the main axis, so that the food which is taken in by any one of these mouths helps to feed the whole community, and circulates freely in the main axis, and in every polyp and swimming-bell. The clusters of tentacles are protected by a shield-like scale (Deckstück), to the nature of which I shall refer hereafter; this scale is triangular, with rounded extremities, and through the middle of it passes a thin tube, which connects with the main axis, making a kind of knee immediately above the point of junction; the upper shield of Fig. 338 shows plainly the mode of connection. The knobs of

Fig. 338.

Fig. 338. Cluster of Medusæ (feeding polyps) of the first kind formed, in the younger stages, with tentacular knob and scale. In the upper part of the figure a closed bud, with an oil-bubble, is seen; this bud is ready to be liberated and become an embryonic community, like Fig. 346.

this kind of tentacles are sole-shaped bodies, paved with a beautifully arranged setting of large lasso-cells, edged in by a large set running round the edge (Fig. 339); these knobs are partly hollow, a portion of the tube of the tentacle extending into it a short distance.

The second kind of feeding polyps (Medusæ) (Fig. 340) resemble the first in every respect except the tentacles; they are, like them, attached to the main axis, and protected by a scale, omitted in the figure; at the proximal end of the polyp we find, however, a cluster of tentacles of a totally different nature from the club-bearing lashes of the first kind; they take their origin as diverticula of the wall of the polyp, as those of the first kind; they never grow long, scarcely extending the length of the polyp, but are twisted closely when fully developed, though in their earlier stages they are more corkscrew-shaped, and coiled quite loosely. The whole surface of these tentacles

Fig. 340.

Fig. 339.

Fig. 341.

is covered by a regular pavement of lasso-cells of the same size; the lasso-cells in the young tentacles are only found on the edge; as they increase in length, the tentacles become more thickly covered, until, when closely coiled, they have the pavement described above. There are generally from five to six (Fig. 340) of these large tentacles, and about as many more, in different stages of development, at the base of each of these polyps; while of the first kind of tentacles we rarely find more than three long threads, though there is a thick cluster of embryonic ones adjoining them ready to develop and take their place if any accident should happen to the longer meshes.

The third kind of polyp (Medusæ), which is found along the axis, are polyps with closed extremities (Fig. 341), differing besides from the others in having only one long, slender tentacle at the proximal ex-

Fig. 339. Enlarged view of the knob of a tentacle of the first kind of Medusæ.

Fig. 340. The second kind of Medusæ, having cork-shaped tentacles. The scales in this and following figure are omitted; they differ in no respect from those of Fig. 338.

Fig. 341. Third kind of Medusa, having only a single thread-like tentacle, and a closed proboscis.

tremity, and being perfectly colorless; this tentacle is three or four times the length of the polyp, and is covered with patches of small lasso-cells scattered irregularly over its surface; the walls of this polyp are thick, and are not capable of extensive expansion or contraction, or of any remarkable alteration of shape, as the former kinds. There is still a fourth kind of appendage formed here and there along the stem, one of which is figured on the top of Fig. 338, which resembles this last kind of polyp, being closed, like it, at the extremity, but having neither scale nor tentacles of any kind, and in the proximal end of which we notice an accumulation of oily matter; these I simply mention here, and shall return to them hereafter.

The new polyps which are added to the community take their origin from the cluster of buds situated beneath the swimming-bells; like the swimming-bells, they are formed by the bulging of the wall of the main axis (Fig. 342); they very soon assume the general aspect of feeding polyps, though they remain closed at their distal extremity after they have attained a considerable size (*p*, *p'*, *p''*, Fig. 342); the scarlet pigment-cells make their appearance at a very early period, so that we are able, in very young buds, to recognize the nature of the future polyps; as soon as the polyp buds are slightly more advanced than they are in the figure here given (Fig. 342), the nature of the tentacular buds at the base, and the total absence of pigment-cells in some of the larger closed buds, enables us readily to decide to which kind of polyps (Medusæ) these different buds will give rise; the peculiar sole-shaped knobs of one of the kinds of tentacles are nothing but an expansion of the original diverticulum at the base of the polyp; the different phases through which the knobs pass are very easily followed by examining the various stages of growth found in a cluster of tentacles, such as is represented in Fig. 338 (somewhat enlarged in Figs. 343, 344), until they attain the shape represented in Fig. 339. They are at first a narrow bag, with a few scattered lasso-cells (*a*, Fig. 343), then the thickness of the wall at the extremity increases, the lasso-cells at the same time becoming large (*b*, Fig. 343). In the next stage, when seen in profile, the sac has assumed a hook-shaped form (*c*, Fig. 343), the bend becomes still more marked, and the lasso-cells are now arranged in a row along the extremity (*d*, Fig. 343); the walls become thicker as the lasso-cells

Fig. 342.

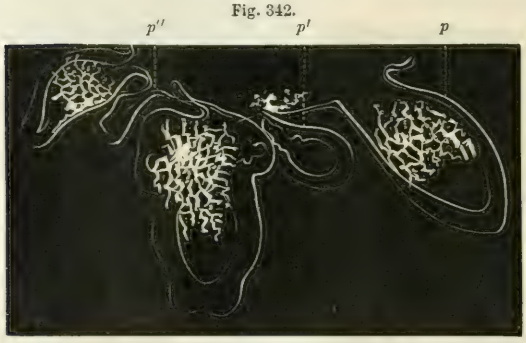


Fig. 342. Cluster of Medusæ (feeding polyps) in different stages of development, before the appearance of the scale or of the tentacles. *p*, oldest; *p'*, somewhat younger; *p''*, still younger.

become more numerous and larger, the knob assuming more a ladle-shape (*e*, Fig. 344); there is then formed a still larger row of lasso-cells, extending along the edge, and concealing the others (*f*, Fig. 344), making a kind of binding when seen from above (*g*, Fig. 344), where we find all the peculiar characteristics of the sole-shaped, lasso-paved knob of Fig. 339, the only difference in the older knobs being the greater size of the outer row of lasso-cells, and their closer packing, which conceals entirely the cavity running into the knob, while it is plainly visible in younger tentacles.

The perfectly free and open communication we find between all the parts of the community, except the float, is one of their most striking characteristics; there is not an appendage into which the food taken in by any one of these feeding polyps (Medusæ) cannot circulate into its very extremity; even the scales, which seem in their full-grown state

Fig. 343.

Fig. 344.

Fig. 345.

to consist of nothing but a gelatinous shield, with a very narrow tube passing through the middle, are, when developing, open pouches leading at once into the main cavity of the axis, and even after the buds can distinctly be recognized as undeveloped scales (Fig. 345), the cavity occupies a much greater part of the scale than in the adult, as is readily seen in the different views of one of the scales (*a*, *b*, *c*, Fig. 345). In the view from above, *a*, the triangular shape is already apparent; a profile view, *b*, shows its greater thickness than in a fully-developed scale, while in an end view, *c*, it is still quite pentagonal.

Besides these different kinds of appendages, we find the sexual individuals scattered in small clusters of abortive Medusæ near the lower extremity of the axis, generally in the third nearest the terminal

Fig. 343. *a*, *b*, *c*, *d*, tentacular knobs like those of Fig. 339, in different stages of development.

Fig. 344. *e*, *f*, *g*, the same tentacular knobs, still further developed.

In Figs. 343 and 344 all the figures are seen in profile, except *b* of Fig. 343, and *g* of Fig. 344, which are seen from the flat side, to show the arrangement of the lasso-cells.

Fig. 345. Young scale; seen from above, *a*; in profile, *b*; and endways, *c*.

polyp ; as has already been shown by Sars in Agalmopsis, the sexes are distinct, so that we have whole communities, the sexual Medusæ of which are either males or females. There is no great difference between the appearance of the male and female Medusæ ; they do not (as is the case in Agalmopsis, according to Sars) separate from the community, and lead an independent existence ; they wither on the stem, after having discharged their contents. The Medusæ form bunches, the single Medusæ of which are directly attached to the main axis ; they are somewhat pointed in outline, with four tolerably well defined chymiferous tubes, resembling quite closely the sessile Medusæ of such Tubularians as *Tubularia Couthouyi*.

Fig. 346.

From the observations of Gegenbaur, there can be no doubt that many of the Siphonophores are, like Nanomia, developed directly from the egg, and that the embryo which comes from the egg is one which is identical with those found floating about in such immense numbers during the early part of June, and which are figured in Fig. 346, consisting of a single closed polyp and of an oil-float, separated by a partition, as in the adult (Fig. 331) ; this simple polyp is to be the axis of the future community. But these young Nanomiæ (Fig. 346) do not all arise from eggs, and pass directly into an embryo like Fig. 346 ; we have a second kind of development, that of budding. In Fig. 338 there is represented on the top an appendage resembling somewhat a polyp without an opening, having neither tentacle nor protecting scale. A bubble of oil is collecting at the proximal extremity ; as this bubble increases in size, the neck which connects the polyp with the main axis gradually becomes narrower and narrower, until the connection is finally cut, and we have a bud resembling in every respect Fig. 346, which has separated from the main community. By keeping in confinement, entirely isolated, an adult Nanomia having many of these buds along the main axis, I have found after a few days a large number of these buds liberated, which had assumed the shape and structure of Fig. 346, and had grown to be similar in every respect to the embryos I was fishing from the sea at the same time. From this I should infer that we have two broods of adults, those which are found in the fall, and which lay eggs in October and November, and those which are probably formed by budding from the older ones during the summer and winter ; the embryos found in early summer may have come from the eggs of either of these.

Fig. 347.

The young embryos (Fig. 346) readily keep alive in confinement, and it is a comparatively easy thing to trace the successive stages of a

Fig. 346. Youngest Nanomia found swimming on surface.
Fig. 347. Somewhat more advanced.

further development; the terminal Hydra of Fig. 346 increases greatly in size; a number of buds make their appearance on both sides of the axis, immediately at the base of the float; these buds are nothing but the rudimentary swimming-bells, the so-called polyps and the tentacles. (Fig. 347.) As the young Nanomia grows larger, these buds increase in size, and we can soon trace in some of them undoubted polyps, with an open mouth, and the rudimentary tentacular knobs accompanying them; immediately at the base of these polyps there is a small transparent protuberance, the first appearance of the protecting scale. The terminal polyp of this diminutive community increases greatly in size, becomes open at the extremity, and covered irregularly with large

Fig. 348.

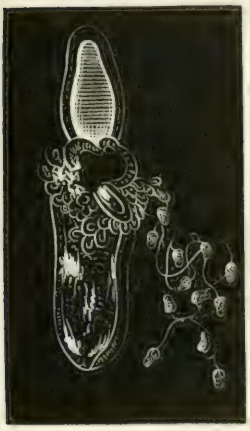


Fig. 349

Fig. 350.

patches of scarlet pigment-cells; the tentacles become longer, and when they equal in length that of the community, from six to eight knobs hang from the main threads. (Fig. 348.) In somewhat more advanced specimens, we find protecting scales already quite well developed (Fig. 349), and besides many additional polyps in different stages of development, such as are figured in Fig. 342; the buds immediately under the float, the nature of which seemed still doubtful in the last stage (Fig. 348), are now seen to be rudimentary swimming-bells, some of them nearly as advanced as those represented in Fig. 337; these rudimentary parts grow now with great rapidity, the clusters of the

Fig. 348. The terminal Hydra is open, tentacles are developed, as well as clusters of small swimming-bells, like those of Fig. 337, and of Medusæ (feeding polyps), like those of Fig. 342.

Fig. 349. Still more advanced Nanomia.

Fig. 350. Young Nanomia, where we find several Medusæ (feeding polyps) of the first kind, having all the characters of those found in the adult (Fig. 332), and embryonic swimming-bells.

different kinds of individuals taking the place we find them occupying in the adult; the swimming-bells are placed immediately under the float, and the polyps between them and the primitive polyp. The protecting scales increase rapidly, and in Fig. 350 we have a young Nanomia having two well-developed polyps, as many scales, and as many tentacles, one of the polyps being the first terminal one, and the other a lateral polyp, at the base of which are found the rudimentary tentacles, while immediately under the float we find a cluster of rudimentary swimming-bells, as far developed as those of Fig. 337.

From this point there is no doubt that we have before us a young Nanomia, and the future phases of the development are only changes of quantity. The various members of the community have, however, a very different degree of development. What is particularly characteristic of the young Nanomia is that it is entirely composed of the polyp element, and of the polyps with knobbed appendages; it is only somewhat later that the scales make their appearance, and we then have a sufficient number of these polyps added to make quite an extensive community before any other kind is formed, and before the swimming-bells are developed. We generally find a couple of large swimming-bells preceding the appearance of the second kind of polyp (Fig. 339); it is not till still later that the Hydrocysts (Fig. 341), as Huxley has called the closed polyps, make their appearance. The remaining swimming-bells are slow in their development; we do not usually find more than two in quite large specimens, and it is only in the adult, where we find the buds which are to separate as young floats and where the sexual individuals have begun to make their appearance, that there are from four to six swimming-bells. (Fig. 332.)

From this slight sketch of the order of succession of the different individuals, we have the means of dividing all the Siphonophores into three great suborders, according to the degree of development of the three principal elements. Lowest are those in which the float has the greatest predominance, and in which the different individuals of the community appear as secondary appendages, such as Porpita, Velella, and Physalia; in the second suborder we have the various stages of combinations of the hydrarium and the swimming-bell elements, in the following forms, — Rhisophyza, Apolemia, Agalma, Nanomia, Halistemma, Stephanomia, and Forskalia; while in the third and highest suborder we find the greatest development of the swimming-bells, accompanied by a reduction in the number of individuals forming a single community, and a further specialization of parts not found in the preceding orders. The different appendages which are found along the axis of these floating Hydroids have been considered by most English investigators as simple organs, while the greater number of German writers believe them to be different kinds of individuals, form-

ing together a community, and not a single animal, as maintained by the former. The solution of this question has been considered in various ways by Agassiz, Kölliker, Vogt, Leuckart, Gegenbaur, and Huxley. Professor Agassiz, who was the first to show the homology existing between one of these floating communities and a fixed community of Hydroids such as Hydractinia, has, it seems to me, given the correct account of these animals. According to him, and the principal points of this view have afterwards been proved independently by Vogt, and also developed further, from Professor Agassiz's lectures, by McCrady, a Siphonophore is neither a single animal, and its different appendages simply organs, nor, according to the opposite and more extreme view of Leuckart, does he push the polymorphism to such an extent as to consider all the appendages, such as the tentacles and scales, as independent individuals; he compares one of these communities to the different kinds of individuals found in a Hydractinia community, and thus shows beyond doubt that the Siphonophores are not a natural order of the Acalephs, but simply different suborders of the order of Hydroids; the fact that they move about as free communities does not separate them from the fixed Hydroids; it would be as unnatural to remove into different orders the free swimming Halcyonoids, such as Renilla, Veretillum, and the fixed Gorgonia or Halcyonium. It has already been fully shown by Vogt that the swimming-bells of Agalma and the like are only Medusæ differing from the Hydroid Medusæ in the absence of a free proboscis and of an opening communicating directly with the surrounding medium. The swimming-bells of Nanomia are nothing but Medusæ having complicated chymiferous tubes, remaining almost always attached to the community, and performing their part of the work. They are the locomotive individuals of the community; to them is intrusted the carrying about the whole of this fraternity, while different functions belong to the other individuals, some of them feeding the community, others serving to reproduce it by budding, while others again reproduce it by laying eggs.

The nature of the different kinds of polyps found along the axis does not seem to have been correctly understood; we can compare them, in a general way, to the different kinds of individuals found in a Hydractinia community; it seems to me that the only parts which can be homologized to one of these fixed Hydroids are the float, the original polyp, and the buds (top of Fig. 338) which drop off. These are in reality the floating Hydroid, and the other individuals, developed as the axis or original Hydroid becomes larger, are not Polyps like the original one, but Medusæ in various stages of development, having a different appearance from those we are accustomed to consider as such. We have, in the suborders of Siphonophoræ, communities of different kinds of Medusæ, instead of having communities of different kinds of

Hydroids, as in Hydractinia, only these Medusæ never separate from the original parent-stock from which they are produced. The float corresponds to the part of the stem of the fixed Hydroids by which they are attached, and the different individuals arising from this single Polyp are Medusæ. To show the Medusa character of these individuals, I must preface by saying that the tentacles, the Polyp, and the scale are not so many independent individuals, but that these three together form one individual, the Medusa. It is true this will appear, at first sight, rather doubtful; we are accustomed to associate with our notion of Medusa a regularly-shaped bell, chymiferous tubes, and a proboscis. But this is not the universal character of Medusæ; the abortive sessile Medusæ of Sertularians, Campanularians, and Tubularians are as much Medusæ, though they have no proboscis and nothing but rudimentary chymiferous tubes, as a free-swimming Sarsia or Bougainvillia. The moment this is understood, a new light is thrown on the nature of the individuals of our community. We find among the Hydroids all the stages intermediate between a rudimentary Medusa, as that of Laomedea or of Dynamena, and that of a symmetrical Medusa like Sarsia. We have those in which the proboscis is quite well developed, others in which the chymiferous tubes are always rudimentary, others which are asymmetrical, as Hybocodon, and the different spheromeres of which have not an equal degree of development. This gives us the clew to the true understanding of the relation between the clusters of tentacles, the scale, and the Polyp; let us take one of these Hybocodon Medusæ, cut away the two lateral spheromeres of the bell, and at the same time reduce the spheromere which bears the long tentacle to its minimum, that is, bring the tentacle to the point of junction of the proboscis and of the chymiferous tubes, cut the remaining spheromere in any shape we please, triangular or pentagonal, and we have a Medusa identical in every respect to those of our community. The cluster of tentacles corresponds to the single tentacle, the scale with its tube corresponds to the remaining spheromere and its chymiferous tube, while the proboscis and the Polyp are identical, and perform one and the same function. The fact that there is or is not a chymiferous tube extending through the scale, as in Fig. 338, does not invalidate this homology; for the chymiferous tubes in many Hydroid Medusæ are exceedingly rudimentary, and in that case it would only be carrying out for free Hydroids what has become perfectly familiar to us among the fixed Hydroids.

By reducing this proposition to a mathematical form, I may perhaps give the reader a better idea of the process I am endeavoring to explain, by supposing an equation of the *n*th degree to represent the formula of a Hydroid Medusa, the roots of which are represented by the different spheromeres; they all become imaginary in our Nanomia,

with the exception of one root, which is positive, and this would represent the only remaining spheromere, that of the Deckstück.

If this view is correct, it is evident that the opinion of Huxley, who considers the scale as homologous to the urn of Campanularians, cannot be sustained. I have already hinted at the similarity of the embryonic Nanomia, in the stage of Fig. 347, when it consists of only the large Polyp and the float, with the early stages of the fixed Hydrarium of Melicertum, where we have at first a single Polyp, from which are developed, by budding, the branches and the other kinds of individuals of the community; supposing this community, instead of fixing itself, as it does, to remain movable, the base of the stem to expand into a float and become separated from the main cavity, we should have a Siphonophore. The discovery by McCrady and Stimpson of the floating Hydrarium of Nemopsis and Acaulis, where the Medusæ are closely related to genera the Hydrarium of which is always fixed, reduces still further the distinction which has been made of Polypi Nechali. And when we find that there are genuine Medusæ (Dysmorphosa) which for four generations reproduce themselves by budding from the proboscis, exactly in the same way in which we find additional individuals arising along the walls of the original Polyp among Physophoridæ, we are at a loss to find any distinctions to separate the Siphonophores from the true Hydroids, and we cannot consider them as anything but floating Hydroid communities.

Massachusetts Bay, Nahant, and Newport, R. I. (A. Agassiz).

Cat. No. 365, Nahant, Mass., September, 1862, A. Agassiz.

Museum Diagram, No. 27, after A. Agassiz.

Suborder PORPITÆ Goldf.

Porpitæ Goldf. Handb. der Zool. 1820.
Porpitæ and *Physaliæ* Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.
Chondrophoræ Cham. et Eys. Acta Nova, X.

From a comparison of the young stages of Nanomia with the known Siphonophoræ, I have been induced to extend the limits of this suborder so as to include Physalia, forming thus three suborders among Hydroids of the old order of Siphonophoræ, the Diphyæ, the Physophoræ, and the Porpitæ.

Family PHYSALIDÆ Brandt.

Physalidæ Br.; in Mém. Acad. St. Petersb., p. 236. 1835.
Physalidæ Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.

PHYSALIA Lamk.

Physalia Lamk. An. s. Vert., III. p. 89. Second Edition.
Arethusa Brown. Nat. Hist. Jam.
Arethusa Less. Zooph. Acal., p. 530. 1843.
Physalia Agass. Cont. Nat. Hist. U. S., IV. pp. 335, 366. 1862.

Fig. 351.

Physalia Arethusa Til.

Physalia Arethusa Til.; in Krusenst. Reise, Pl. 23, Figs. 1–6. 1813.
Physalia Arethusa Olf.; in Mem. Berl. Acad., Pl. 1. 1832.
Physalia Arethusa Agass. Cont. Nat. Hist. U. S., IV. pp. 335, 367, Pl. 35. 1862.
Physalia pelagica Bosc. Hist. Nat. d. Vers, II. p. 168.
Physalia aurigera McCr. Gymn. Charleston Harbor, p. 74.

Physalia Arethusa (Fig. 351) is probably carried by the Gulf Stream as far as the Azores. A species has been described by Lesson as *Physalia azoricum*, which may be only the young of *Physalia Arethusa*. (See Voyage de la Coquille, Plate 5, Fig. 4.) To facilitate the comparison of the different kinds of individuals found in communities of this family with those of Nanomia, groups

Fig. 351. Physalia Arethusa Til. Figs. 351–354 are copied from Professor Agassiz's Contributions. *a*, blunt end of air-sac supporting the community; *b*, open end of air-sac; *c*, crest of air-sac; *m*, bunches of single individuals; *n*, tentacle contracted; *t*, *t*, tentacles of the largest kind expanded.

of Hydræ and of Medusæ (Figs. 352, 353, 354) are introduced here.

Fig. 353.

Fig. 352

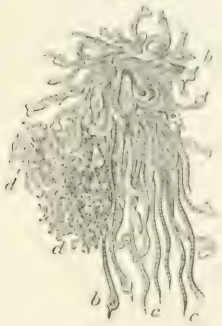
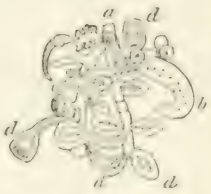


Fig. 354.



Charleston (McCrady); Gulf of Mexico (Brown, Sloane); Florida (L. Agassiz); Cape Cod (A. Agassiz); Martha's Vineyard (W. H. Forbes).

Cat. No. 305, Florida, 1850, L. Agassiz.
Cat. No. 306, Florida, 1850, L. Agassiz.
Cat. No. 307, Florida, 1850, L. Agassiz.
Cat. No. 308, Key West, Fla., February, 1858, L. Agassiz.
Cat. No. 309, Key West, Fla., March, 1858, L. Agassiz.
Cat. No. 310, Tortugas, Fla., February, 1858, L. Agassiz.
Cat. No. 311, New Providence, Bahamas, April, 1861, F. G. Shaw.
Cat. No. 312, Mobile, Alabama, L. Agassiz.
Cat. No. 313, 40° N. Lat., 60° W. Long., Captain W. H. A. Putnam.
Cat. No. 314, Naushon, Mass., 1861, W. H. Forbes.
Cat. No. 325, Tortugas, Fla., March, 1858, L. Agassiz.
Cat. No. 385, Beaufort, N. C., May, 1863, A. S. Bickmore.
Cat. No. 386, Bermudas, A. S. Bickmore.
Museum Diagram, No. 28, after L. Agassiz.

Fig. 352. Bunch of single Hydræ, and clusters of Medusæ, of Physalia Arethusa Til. *b*, *b*, Hydræ, with their tentacles, *c*, *c*; *d*, *d*, bunches of tentacles.

Fig. 353. Bunch of Hydræ. *a*, hollow base of attachment communicating with air-sac; *b*, *b*, *b*, single Hydræ; *c*, *c*, tentacles.

Fig. 354. Bunch of Medusæ in various stages of development. *a*, hollow base of attachment: *b*, Hydra; *d*, *d*, Medusæ buds.

Family VELELLIDÆ Esch.

Velellidæ Esch. (*restr.* Agass.). Syst. d. Acal., p. 165. 1829
Velellæ Less. Zooph. Acal., p. 560. 1843.
Velellidæ Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.

VELELLA Lamk.

Velella Lamk. Anim. s. Vert., II. 1819.
Velella Less. Zooph. Acal., p. 562. 1843.
Velella Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.
Rataria Esch. Syst der Acal., p. 166. 1829.
Chrysomitra Gegenb.; in Zeit. f. Wiss. Zool., p. 231. 1856. Medusa.
Linuche Esch. Syst. der Acal., p. 91. 1829. Medusa.
? Rataria Pagenst.; in Zeit. f. Wiss. Zool., XII. p. 496. 1863.

Velella mutica Bosc.

Velella mutica Bosc. Hist. Nat. d. Vers, II. p. 158.
Velella mutica Less. Voyage de la Coquille, Pl. 6. 1829.
Velella mutica Less. Zooph. Acal., p. 571. 1843.
Velella mutica Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.

The free Medusa of Velella resembles so exactly that produced by some of the Tubularians — Euphysa and Globiceps, for example — that it would seem the most natural thing to place these Medusæ among Tubularians, as McCrady has done; but the polymorphism of the

Fig. 356.

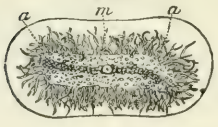
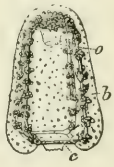


Fig. 355.

Fig. 357



Hydræ (Fig. 355) and the presence of the float (Fig. 356) associate the Hydrarium with the Porpitæ. The free Medusa is but another link showing how close is the relation between the floating and fixed Hydroids. The Medusa figured here (Fig. 357) is one which has just freed itself. The chymiferous tubes, as well as the proboscis, are of a

Fig. 355. An enlarged view of one of the fertile Hydræ of Velella. *a*, base of attachment of Hydra; *b*, end of Hydra; *d*, *d*, clusters of Medusæ. All these figures are copied from Professor Agassiz's Contributions, Vol. III.

Fig. 356. Velella, seen from below, to show the Hydræ. *m*, opening, so-called mouth; *a*, fertile Hydræ situated between the mouth and the outer tentacles, the sterile Hydræ.

Fig. 357. Magnified view of a free Medusa of Velella mutica Bosc. *o*, proboscis; *b*, chymiferous tube; *c*, circular tube.

brilliant ochre color. Professor Agassiz has observed this Medusa four days after it became free, when the Medusa had become quite globular, having lost entirely its elongated shape.

Long Island Sound (A. Agassiz); Gulf of Mexico (Bosc); Coast of Florida (L. Agassiz).

Cat. No. 296, Florida, 1850, L. Agassiz.

Cat. No. 297, Fort Jefferson, Fla., April, 1859, Dr. D. W. Whitehurst.

Cat. No. 298, Key West, Fla., March, 1858, J. E. Mills.

Cat. No. 299, Cape Florida, April, 1858, G. Wurdeman.

Cat. No. 300, Cape Florida, G. Wurdeman.

Cat. No. 301, Tortugas, Fla., April 2, 1858, L. Agassiz.

Cat. No. 302, Tortugas, Fla., April, 1858, J. E. Mills.

Museum Diagram, No. 27, after L. Agassiz.

Velella septentrionalis Esch.

Velella septentrionalis Esch. Syst. der Acal., p. 171, Pl. 15, Fig. 1. 1829.

Numerous specimens were collected at the entrance of the Straits of Fuca. The proportions of this species are quite different from those of our West Indian *V. mutica*. The figure given by Eschscholtz gives a good idea of the almost square outline of the float.

In company with *V. septentrionalis* was always found a Physalia, which I have been unable to refer to any of the described species. As the specimens of both were lost, they are mentioned here for the sake of the geographical distribution of these animals.

Northwest coast of America (Eschscholtz); Straits of Fuca (A. Agassiz, October, 1859); San Francisco Bar (A. Agassiz, October, 1859).

Family PORPITIDÆ Guild.

Porpitidæ Guild.; in Zool. Journ., XI. p. 403.
Velellidæ Esch. (*p. p.*). Syst. der Acal., p. 165. 1829.
Porpitidæ Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862
Porpitæ Less. Voyage de la Coquille, II. p. 55. 1829.

PORPITA Lamk.

Porpita Lamk. Anim. s. Vert., II. 1819.
Porpita Less. Zooph. Acal., p. 583. 1843.
Porpita Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.
Polybrachiona Guild.; in Zool. Journ., XI.
Ratis Less. Zool. de la Coquille. 1829.
Acies Less. Zool. de la Coquille. 1829.
? Armenistarium Costa. Faune de Naples.

Porpita linnæana Less.

Porpita linnæana Less. Zooph. Acal., p. 588. 1843.
Polybrachionia linnæana Guild.; in Zool. Journ., XI. Fig.
Porpita linnæana McCr. Gymn. Charleston Harbor, p. 42.
Porpita linnæana Agass. Cont. Nat. Hist. U. S., IV. p. 366. 1862.
? Porpita atlantica Less. Voy. de la Coquille, Pl. 7, Fig. 2.

West Indies (Guilding); Florida (L. Agassiz); Charleston, S. C. (McCrady).

Cat. No. 289, Fort Jefferson, Fla., April, 1859, Dr. Whitehurst.

Cat. No. 290, Pensacola, Fla.

Cat. No. 291, Key West, Fla., L. Agassiz.

Museum Diagram, No. 27, after L. Agassiz.

Suborder TABULATÆ Agassiz.

Tabulatæ Agass. Sill. Journ., XXVI. p. 140. 1858.
Corallaria Tabulata Edw. & Haime. Archiv du Mus., V.
Madreporaria Tabulata Edw. & Haime. Hist. Corall., III. p. 223. 1860.
Tabulatæ Agass. Cont. Nat. Hist. U. S., IV. p. 292. 1862.

Family MILLEPORIDÆ Agass.

MILLEPORA Linn.

Millepora Linn. Syst. Nat.

Millepora alcicornis Lin.

Millepora alcicornis Lin. Syst. Nat., X. 1758.
Millepora alcicornis Dana. U. S. Ex. Exp. Zoophytes, p. 543.
Millepora alcicornis Edw. & Haime. Hist. Corall., III. p. 228.
Millepora alcicornis Agass. Cont. Nat. Hist. U. S., III. p. 292, Pl. 15, Figs. 3–13. 1860.
Millepora alcicornis Verrill; in Bull. Mus. Comp. Zoöl., p. 59, No. 3. 1864.

The absence of radiating partitions in the Tabulatæ seems to show, without much doubt, that their true place is among the Hydroids. It is true that Professor Agassiz has not observed the Medusæ buds on the specimens he has figured (Fig. 358), yet the Hydroid character of the animal, and their similarity to Halocharis-like Hydroids, is very

Fig. 358.

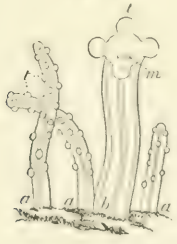


Fig. 359.

Fig. 360.

striking. It certainly is not more wonderful to have among Acalephs Hydroids which should deposit hard limestone parts (Figs. 359, 360), as Millepora and the like, than it is to find among the Polyps animals in which we find partitions of every stage of hardness, from a gelatinous or a horny nature, to the most solid deposits of limestone. We have already something of the same diversity in the formation of the

Fig. 358. Magnified view of extended Hydroids of Millepora. *a*, *a*, small Hydroids; *b*, larger ones; *m*, mouth; *t*, tentacles.
Fig. 359. Branch of Millepora alcicornis; natural size.
Fig. 360. Transverse section of branch. *a*, *a*, pits of Hydroids.

different kinds of sheaths of the Sertularians and of the Campanularians, and especially in the great development of the horn-like network forming the base of a Hydractinia colony, and the limestone floors deposited by the base of the animal of Millepora is only an extreme case for Acalephs, similar to the solid radiating partitions of the Madrepores among Polyps.

Tortugas, Fla. (L. Agassiz).

Cat. No. 382, Tortugas, Fla., March, 1858, L. Agassiz.

GEOGRAPHICAL DISTRIBUTION.

For the sake of showing more strikingly the character of the different Acalephian Faunæ of our coasts, lists have been prepared embracing several species not enumerated in the Catalogue, to give a better idea of the peculiar stamp of the regions into which our coast has been divided. No names are here given to these faunal divisions, as in a forthcoming number of the Museum Catalogue the limits and nomenclature of our Marine Faunæ will be fully discussed. For the present I shall simply point out in a general manner some of the more interesting points of the distribution of our Acalephs. Several species have a very extensive range; on the Atlantic side, from Greenland to Long Island Sound, and from Grand Manan to Charleston, South Carolina. In the Pacific Ocean we find species which range from Kamtschatka to the northern part of California. Within these extensive belts there are other species more limited in range, extending only from Massachusetts Bay to Eastport, from Charleston to Cape Cod, from San Francisco to the Gulf of Georgia, or from the Gulf of Georgia to Behring's Straits; while a third series of species is still more limited, extending only along such portions of the shores as Nova Scotia, Massachusetts Bay, Long Island Sound, the coast of Southern California, the Gulf of Georgia, and the like.

The areas of distribution of the different species overlap and enclose one another so as to give us for the character of the Fauna of any particular locality three different elements of distribution; first, the cosmopolitan species, spreading over wide areas; next, the species which range over more limited areas; and finally, the local species scattered in the areas of the limited species. It is the peculiar combination of these three elements which gives to a special locality what has been called its faunal character, but owing to the intricate crossing, overlapping, and enclosing of these areas, we find it nearly impossible to draw lines along our coast which should embrace homogeneous elements. Such areas are found on our coast, extending approximately from Greenland to the northern part of Nova Scotia, from Nova Scotia to the northern part of Maine, and from Massachusetts Bay to Cape Cod; the coast of Long Island Sound and New Jersey, as far as Cape Hat-

teras, presents features of its own; the coast of the Carolinas and Georgia has likewise distinct faunal features, while Florida and the West Indies have each their peculiar Acalephs, though the boundaries of the distribution of many of the species, found in each of those divisions, extend far beyond the limits we have here assigned to the regions. On the Pacific side of North America, we find the great belt of the Northern Pacific extending from the shores of Kamtschatka to British North America; the inland sea behind Vancouver's Island and the mainland has a characteristic fauna, and along the coast of California itself still different Medusæ are found. The association of the three elements mentioned above being so different at certain localities, we naturally come to look upon them as centres from which the species of a fauna are derived, while in reality it is only the peculiar combinations of the geographical extension of each species which give the distinguishing features to each locality.

NORTH PACIFIC.

SITKA, ALEUTIAN ISLANDS, BEHRING'S STRAITS, KAMTSCHATKA.

Bolina septentrionalis Mert.	Behring's Straits.	Mertens.
Janira cucumis Less.	Sitka.	Mertens.
Dryodora glandiformis Ag.	Behring's Straits.	Mertens.
Phacellophora camtschatica Br.	Kamtschatka.	Mertens.
Cyanea Postelsii Br.	Sitka.	Mertens.
Cyanea ferruginea Esch.	Aleutian Islands; Kamtschatka.	Eschscholtz.
Pelagia Brandtii Ag.	Aleutian Islands.	Mertens.
Polybostricha helvola Br.	Aleutian Islands.	Mertens.
Melanaster Mertensii Ag.	Kamtschatka.	Mertens.
Æginopsis Laurentii Br.	Behring's Straits.	Mertens.
Trachynema camtschaticum A. Ag.	Kamtschatka.	Mertens.
Staurophora Mertensii Br.	Aleutian Islands.	Mertens.
Diphasia (*nigra*-like)	Behring's Straits.	W. Stimpson.
Sertularia (*abietina*-like)	Behring's Straits.	W. Stimpson.
Cotulina Greenei A. Ag.	Behring's Straits.	W. Stimpson.
Thuiaria (*thuja*-like)	Behring's Straits.	W. Stimpson.
Bougainvillia Mertensii Ag.	Behring's Straits	Mertens.
Proboscidactyla flavicirrata Br.	Kamtschatka.	Mertens.

GULF OF GEORGIA, W. T.

Bolina microptera A. Ag.	A. Agassiz.	*Polyorchis penicillata* A. Ag.	A. Agassiz.
Pleurobrachia Bachei A. Ag.	A. Agassiz.	*Laodicea cellularia* A. Ag.	A. Agassiz.
Idyia cyathina A. Ag.	A. Agassiz.	*Gonionemus vertens* A. Ag.	A. Agassiz.
Heccædecomma ambiguum Br.	A. Agassiz.	*Melicertum georgicum* A. Ag.	A. Agassiz.
Cyanea Postelsii Br.	A. Agassiz.	*Bougainvillia Mertensii* Ag.	A. Agassiz.
Trachynema camtschaticum A. Ag.	A. Agassiz.	*Stomotoca atra* A. Ag.	A. Agassiz.
Oceania gregaria A. Ag.	A. Agassiz.	*Proboscidactyla flavicirrata* Br.	A. Agassiz.
Crematostoma flava A. Ag.	A. Agassiz.	*Coryne rosaria* A. Ag.	A. Agassiz.
Zygodactyla cœrulescens Br.	A. Agassiz.	*Physalia sp.*	A. Agassiz.
Æquorea ciliata Esch.	A. Agassiz.	*Velella septentrionalis* Esch.	A. Agassiz.
Laomedea pacifica A. Ag.	A. Agassiz.	*Porpita sp.*	A. Agassiz.

SAN FRANCISCO, CALIFORNIA.

Aurelia labiata Cham. & Eys.	A. Agassiz.	*Sertularia gracilis* A. Ag.	Trask.
Phacellophora camtschatica Br.	A. Agassiz.	*Sertularia furcata* Trask.	Trask.
Polybostricha helvola Br.	A. Agassiz.	*Sertularia turgida* Trask.	Trask.
Melanaster Mertensii Ag.	A. Agassiz.	*Cotulina Greenei* A. Ag.	Murray.
Laomedea rigida A. Ag.	A. Agassiz.	*Bougainvillia Mertensii* Ag.	A. Agassiz.
Laomedea pacifica A. Ag.	A. Agassiz.	*Coryne rosaria* A. Ag.	A. Agassiz.
Polyorchis penicillata A. Ag.	A. Agassiz.	*Paripha microcephala* A. Ag.	A. Agassiz.
Aglaophenia franciscana A. Ag.	A. Agassiz.	*Thamnocnidia tubularoides* A. Ag.	A. Agassiz.
Diphasia corniculata A. Ag.	Murray.	*Hydra tenuis* Ayres.	Ayres.
Sertularia anguina Trask.	Trask.	*Physalia sp.*	A. Agassiz.

WEST INDIES.

Ocyroe maculata Rang.	Rang.	*Dynamena ostrearum* Duch.	Duchassaing.
Idyia ovata Less.	Brown.	*Dynamena* (*disticha*-like).	Duchassaing.
Polyclonia frondosa Ag.	Poey.	*Zelleria simplex* Duch.	Duchassaing.
Pelagia cyanella Pér. et Les.	Swartz.	*Tubularia Ehrenbergii* Duch.	Duchassaing.
Clytia (*volubilis*-like).	Duchassaing.	*Tubularia Lamourouxii* Duch.	Duchassaing.
Laomedea (*antipathes*-like).	Duchassaing.	*Tubularia glandulosa* Duch.	Duchassaing.
Laomedea (*gracilis*-like).	Weinland.	*Tubularia pinnata* Duch.	Duchassaing.
Aglaophenia pelasgica McCr.	Weinland.	*Physalia Arethusa* Til.	Brown.
Aglaophenia trifida Ag.	Weinland.	*Velella mutica* Bosc.	Brown.
Aglaophenia acinaria Duch.	Duchassaing.	*Porpita linnæana* Less.	Guilding.
Aglaophenia atlantica Duch.	Duchassaing.	*Millepora alcicornis* Lin.	Linnæus.

FLORIDA REEF.

Bolina vitrea Ag.	L. Agassiz.	*Eutima pyramidalis* Ag.	L. Agassiz.
Idyopsis affinis Ag.	L. Agassiz.	*Dynamena sp.*	L. Agassiz.
Polyclonia frondosa Ag.	L. Agassiz.	*Pasithea sp.*	L. Agassiz.
Aurelia marginalis Ag.	L. Agassiz.	*Aglaophenia pelasgica* McCr.	L. Agassiz.
Pelagia cyanella Pér. et Les.	L. Agassiz.	*Aglaophenia trifida* Ag.	L. Agassiz.
Liriope tenuirostris Ag.	L. Agassiz.	*Plumularia quadridens* McCr.	L. Agassiz.
Clytia (*intermedia*-like).	L. Agassiz.	*Plumularia sp.*	L. Agassiz.
Clytia (*volubilis*-like).	L. Agassiz.	*Nigelastrum sp.*	L. Agassiz.
Orthopyxis (*poterium*-like).	L. Agassiz.	*Pennaria gibbosa* Ag.	L. Agassiz.
Laomedea (*amphora*-like).	L. Agassiz.	*Paripha cristata* Ag.	L. Agassiz.
Laomedea (*dichotoma*-like).	L. Agassiz.	*Physalia Arethusa* Til.	L. Agassiz.
Rhegmatodes floridanus Ag.	L. Agassiz.	*Velella mutica* Bosc.	L. Agassiz.
Zygodactyla cyanea Ag.	L. Agassiz.	*Porpita linnæana* Less.	L. Agassiz.
Eirene cærulea Ag.	L. Agassiz.	*Millepora alcicornis* Linn.	L. Agassiz.

CHARLESTON, SOUTH CAROLINA.

Bolina littoralis McCr.	McCrady.	*Oceania folleata* Ag.	McCrady.
Mnemiopsis Gardeni Ag.	L. Agassiz.	*Eucheilota ventricularis* McCr.	McCrady.
Beroe punctata Esch.	McCrady.	*Clytia bicophora* Ag.	McCrady.
Idyopsis Clarkii Ag.	L. Agassiz.	*Platypyxis cylindrica* Ag.	L. Agassiz.
Stomolophus meleagris Ag.	L. Agassiz.	*Eucope divaricata* A. Ag.	L. Agassiz.
Cyanea versicolor Ag.	L. Agassiz.	*Obelia commissuralis* McCr.	McCrady.
Foveolia octonaria A. Ag.	McCrady.	*Eirene gibbosa* Ag.	McCrady.
Persa incolorata McCr.	McCrady.	*Eutima mira* McCr.	McCrady.
Liriope scutigera McCr.	McCrady.	*Eutima variabilis* McCr.	McCrady.

Aglaophenia pelasgica McCr.	McCrady.	*Dipurena strangulata* McCr.	McCrady.
Aglaophenia trifida Ag.	L. Agassiz.	*Dipurena cervicata* McCr.	McCrady.
Aglaophenia tricuspis McCr.	McCrady.	*Corynitis Agassizii* McCr.	McCrady.
Plumularia quadridens McCr.	McCrady.	*Gemmaria gemmosa* McCr.	McCrady.
Plumularia (*Catharina*-like).	L. Agassiz.	*Pennaria tiarella* McCr.	McCrady.
Dynamena cornicina McCr.	L. Agassiz.	*Ectopleura turricula* Ag.	McCrady.
Diphasia (*nigra*-like).	L. Agassiz.	*Paripha cristata* Ag.	L. Agassiz.
Nemopsis Bachei Ag.	McCrady.	*Hydractinia polyclina* Ag.	McCrady.
Margelis carolinensis Ag.	McCrady.	*Eudoxia alata* McCr.	McCrady.
Eudendrium ramosum McCr.	McCrady.	*Diphyes pusilla* McCr.	McCrady.
Turritopsis nutricula McCr.	McCrady.	*Physalia Arethusa* Til.	McCrady.
Stomotoca apicata Ag.	McCrady.	*Velella mutica* Bosc.	McCrady.
Willia ornata McCr.	McCrady.	*Porpita linnæana* Less.	McCrady.

BUZZARD'S BAY AND LONG ISLAND SOUND.

Mnemiopsis Leidyi A. Ag.	A. Agassiz.	*Sertularia cupressina* Lin.	Leidy.
Lesueuria hyboptera A. Ag.	A. Agassiz.	*Nemopsis Bachei* Ag.	L. Agassiz.
Pleurobrachia rhododactyla Ag.	A. Agassiz.	*Bougainvillia superciliaris* Ag.	Leidy.
Cyanea arctica Pér. et Les.	A. Agassiz.	*Margelis carolinensis* Ag.	A. Agassiz.
Cyanea fulva Ag.	A. Agassiz.	*Eudendrium dispar* Ag.	A. Agassiz.
Dactylometra quinquecirra Ag.	A. Agassiz.	*Eudendrium tenue* A. Ag.	A. Agassiz.
Trachynema digitale A. Ag.	A. Agassiz.	*Dysmorphosa fulgurans* A. Ag.	A. Agassiz.
Oceania languida A. Ag.	A. Agassiz.	*Modeeria sp.*	A. Agassiz.
Eucheilota ventricularis McCr.	A. Agassiz.	*Turritopsis nutricula* McCr.	A. Agassiz.
Eucheilota duodecimalis A. Ag.	A. Agassiz.	*Stomotoca apicata* Ag.	A. Agassiz.
Clytia volubilis A. Ag.	A. Agassiz.	*Clava leptostyla* Ag.	Leidy.
Clytia bicophora Ag.	A. Agassiz.	*Willia ornata* McCr.	A. Agassiz.
Platypyxis cylindrica Ag.	A. Agassiz.	*Dipurena conica* A. Ag.	A. Agassiz.
Eucope diaphana Ag.	A. Agassiz.	*Gemmaria gemmosa* McCr.	A. Agassiz.
Obelia commissuralis McCr.	A. Agassiz.	*Pennaria tiarella* McCr.	Ayres.
Laomedea amphora Ag.	A. Agassiz.	*Cordylophora sp.*	Leidy.
Rhegmatodes tenuis A. Ag.	A. Agassiz.	*Ectopleura ochracea* A. Ag.	A. Agassiz.
Zygodactyla groenlandica Ag.	A. Agassiz.	*Hybocodon prolifer* Ag.	A. Agassiz.
Æquorea albida A. Ag.	A. Agassiz.	*Hydra carnea* Ag. (Conn.)	L. Agassiz.
Eutima limpida A. Ag.	A. Agassiz.	*Hydractinia polyclina* Ag.	A. Agassiz.
Lafœa calcarata A. Ag.	A. Agassiz.	*Nanomia cara* A. Ag.	A. Agassiz.
Dynamena pumila Lamx.	A. Agassiz.	*Physalia Arethusa* Til.	A. Agassiz.

MASSACHUSETTS BAY.

Bolina alata Ag.	L. Agassiz.	*Oceania languida* A. Ag.	A. Agassiz.
Lesueuria hyboptera A. Ag.	A. Agassiz.	*Wrightia sp.*	L. Agassiz.
Mertensia ovum Mörch.	A. Agassiz.	*Clytia intermedia* Ag.	L. Agassiz.
Pleurobrachia rhododactyla Ag.	L. Agassiz.	*Clytia bicophora* Ag.	L. Agassiz.
Idyia roseola Ag.	L. Agassiz.	*Clytia volubilis* A. Ag.	L. Agassiz.
Aurelia flavidula Pér. et Les.	L. Agassiz.	*Platypyxis cylindrica* Ag.	L. Agassiz.
Cyanea arctica Pér. et Les.	L. Agassiz.	*Orthopyxis poterium* Ag.	L. Agassiz.
Campanella pachyderma A. Ag.	A. Agassiz.	*Eucope diaphana* Ag.	L. Agassiz.
Trachynema digitale A. Ag.	A. Agassiz.	*Eucope alternata* A. Ag.	A. Agassiz.
Halimocyathus platypus H. J. C.	H. J. Clark.	*Eucope parasitica* A. Ag.	A. Agassiz.
Manania auricula H. J. C.	H. J. Clark.	*Eucope polygena* A. Ag.	A. Agassiz.
Lucernaria quadricornis Müll.	L. Agassiz.	*Eucope pyriformis* A. Ag.	A. Agassiz.
Haliclystus auricula H. J. C.	L. Agassiz.	*Eucope articulata* A. Ag.	A. Agassiz.
Tiaropsis diademata Ag.	L. Agassiz.	*Eucope fusiformis* A. Ag.	A. Agassiz.

Obelia commissuralis McCr.	L. Agassiz.	*Cotulina tamarisca* A. Ag.	L. Agassiz.
Laomedea amphora Ag.	L. Agassiz.	*Halecium halecinum* Johnst.	L. Agassiz.
Laomedea gigantea A. Ag.	H. J. Clark.	*Bougainvillia superciliaris* Ag.	L. Agassiz.
Laomedea reptans Lamx.	L. Agassiz.	*Eudendrium dispar* Ag.	L. Agassiz.
Laomedea sp.	L. Agassiz.	*Eudendrium tenue* A. Ag	A. Agassiz.
Stomobrachium tentaculatum Ag.	L. Agassiz.	*Eudendrium sp.*	A. Agassiz.
Halopsis ocellata A. Ag.	A. Agassiz.	*Lizzia grata* A. Ag.	A. Agassiz.
Halopsis cruciata A. Ag.	A. Agassiz.	*Dysmorphosa fulgurans* A. Ag.	A. Agassiz.
Zygodactyla groenlandica Ag.	L. Agassiz.	*Turris vesicaria* A. Ag.	A. Agassiz.
Zygodactyla crassa A. Ag.	A. Agassiz.	*Turritopsis sp.*	A. Agassiz.
Tima formosa Ag.	L. Agassiz.	*Rhizogeton fusiformis* Ag.	L. Agassiz.
Lafœa cornuta Lamx.	A. Agassiz.	*Clava leptostyla* Ag.	L. Agassiz.
Lafœa dumosa Sars.	A. Agassiz.	*Coryne mirabilis* Ag.	L. Agassiz.
Melicertum campanula Pér. et Les.	L. Agassiz.	*Syndictyon reticulatum* A. Ag.	A. Agassiz.
Staurophora laciniata Ag.	L. Agassiz.	*Gemmaria cladophora* A. Ag.	A. Agassiz.
Ptychogena lactea A. Ag.	A. Agassiz.	*Pennaria tiarella* McCr.	A. Agassiz.
Plumularia arborea Des.	Desor.	*Euphysa virgulata* A. Ag.	A. Agassiz.
Dynamena pumila Lamx.	L. Agassiz.	*Hybocodon prolifer* Ag.	L. Agassiz.
Dyphasia fallax Ag.	L. Agassiz.	*Corymorpha pendula* Ag.	L. Agassiz.
Dyphasia rosacea Ag.	L. Agassiz.	*Paripha crocea* Ag.	L. Agassiz.
Sertularia cupressina L.	L. Agassiz.	*Thamnocnidia spectabilis* Ag.	L. Agassiz.
Sertularia argentea Ell. & Sol.	L. Agassiz.	*Thamnocnidia tenella* Ag.	L. Agassiz.
Sertularia falcata L.	L. Agassiz.	*Tubularia Couthouyi* Ag.	L. Agassiz.
Sertularia myriophyllum L.	L. Agassiz.	*Hydra gracilis* Ag. (Mass.)	L. Agassiz.
Amphitrocha rugosa Ag.	L. Agassiz.	*Hydractinia polyclina* Ag.	L. Agassiz.
Cotulina tricuspidata A. Ag.	L. Agassiz.	*Nanomia cara* A. Ag.	A. Agassiz.

NORTHERN COAST OF MAINE, GRAND MANAN, AND EASTPORT.

Bolina alata Ag.	W. Stimpson.	*Sertularia argentea* L.	J. E. Mills.
Mertensia ovum Mörch.	A. Agassiz.	*Sertularia falcata* Ag.	W. Stimpson.
Pleurobrachia rhododactyla Ag.	W. Stimpson.	*Sertularia latiuscula* Stimps.	W. Stimpson.
Idyia roseola Ag.	W. Stimpson.	*Sertularia myriophyllum* L.	A. E. Verrill.
Aurelia flavidula Pér. et Les.	W. Stimpson.	*Sertularia filicula* Ell. & Sol.	W. Stimpson.
Cyanea arctica Pér. et Les.	W. Stimpson.	*Sertularia producta* Stimps.	W. Stimpson.
Manania auricula H. J. C.	W. Stimpson.	*Amphitrocha rugosa* Ag.	W. Stimpson.
Lucernaria quadricornis Müll.	W. Stimpson.	*Cotulina tricuspidata* A. Ag.	W. Stimpson.
Haliclystus auricula H. J. C.	W. Stimpson.	*Cotulina polyzonias* Ag.	A. E. Verrill.
Haliclystus salpinx H. J. C.	W. Stimpson.	*Cotulina tamarisca* A. Ag.	W. Stimpson.
Oceania languida A. Ag.	L. Agassiz.	*Halecium halecinum* Johnst.	A. E. Verrill.
Clytia volubilis A. Ag.	A. E. Verrill.	*Halecium muricatum* Johnst.	A. E. Verrill.
Clytia bicophora Ag.	W. Stimpson.	*Grammaria gracilis* Stimps.	W. Stimpson.
Orthopyxis poterium Ag.	A. E. Verrill.	*Grammaria robusta* Stimps.	W. Stimpson.
Eucope diaphana Ag.	A. Agassiz	*Acaulis primarius* Stimps.	W. Stimpson.
Eucope pyriformis A. Ag.	J. E. Mills.	*Eudendrium dispar* Ag.	A. E. Verrill.
Obelia commissuralis McCr.	J. E. Mills.	*Coryne mirabilis* Ag.	W. Stimpson.
Laomedea amphora Ag.	J. E. Mills.	*Clava leptostyla* Ag.	W. Stimpson.
Melicertum campanula P. et Les.	L. Agassiz.	*Candelabrum phrygium* Bl.	W. Stimpson.
Staurophora laciniata Ag.	W. Stimpson.	*Corymorpha pendula* Ag.	W. Stimpson.
Dynamena pumila Lamx.	A. Agassiz.	*Thamnocnidia tenella* Ag.	A. E. Verrill.
Diphasia fallax Ag.	W. Stimpson.	*Tubularia larynx* Ellis.	W. Stimpson.
Sertularia abietina L.	J. E. Mills.	*Tubularia Couthouyi* Ag.	W. Stimpson.
Sertularia cupressina L.	W. Stimpson.	*Hydractinia polyclina* Ag.	A. E. Verrill.

NOVA SCOTIA.

Bolina alata Ag.	Anticosti Exp.	*Dynamena pumila* Lamx.	Dawson.
Pleurobrachia rhododactyla Ag.	Anticosti Exp.	*Sertularia abietina* L.	Anticosti Exp.
Idyia roseola Ag.	Anticosti Exp.	*Sertularia argentea* L.	Dawson.
Aurelia flavidula Pér. et Les.	Anticosti Exp.	*Sertularia plumea* Dawson.	Dawson.
Cyanea arctica Pér. et Les.	Anticosti Exp.	*Sertularia falcata* L.	Anticosti Exp.
Haliclystus auricula H. J. C.	Anticosti Exp.	*Sertularia myriophyllum* L.	Anticosti Exp.
Clytia volubilis A. Ag.	Anticosti Exp.	*Sertularia latiuscula* Stimps.	Dawson.
Clytia bicophora Ag.	Anticosti Exp.	*Cotulina tricuspidata* A. Ag.	Anticosti Exp.
Orthopyxis poterium Ag.	Anticosti Exp.	*Cotulina polyzonias* Ag.	Anticosti Exp.
Laomedea (*dichotoma*-like).	Dawson.	*Cotulina tamarisca* A. Ag.	Anticosti Exp.
Laomedea (*gelatinosa*-like).	Dawson.	*Halecium muricatum* Johnst.	Anticosti Exp.
Laomedea (*geniculata*-like).	Dawson.	*Thuiaria thuja* Flem.	Anticosti Exp.
Lafœa cornuta Lamx.	Anticosti Exp.	*Eudendrium* (*ramosum*-like).	Dawson.
Lafœa dumosa Sars.	Anticosti Exp.	*Tubularia larynx* Ellis.	Dawson.
Cosmetira sp.	Anticosti Exp.	*Tubularia Couthouyi* Ag.	Dawson.

GREENLAND.

Mertensia ovum Mörch.	Fabricius.	*Zygodactyla groenlandica* P. et Les.	Fabricius.
Pleurobrachia rhododactyla Ag.	Fabricius.	*Melicertum campanula* Pér. et Les.	Fabricius.
Idyia cucumis Less.	Fabricius.	*Dynamena pumila* Lamx.	Fabricius.
Idyia borealis Less.	Scoresby.	*Sertularia abietina* L.	Fabricius.
Aurelia flavidula Pér. et Les.	Fabricius.	*Sertularia argentea* L.	Fabricius.
Cyanea arctica Pér. et Les.	Fabricius.	*Amphitrocha rugosa* Ag.	Fabricius.
Chrysaora heptœna Pér. et Les.	Martens.	*Cotulina polyzonias* Ag.	Fabricius.
Trachynema digitale A. Ag.	Fabricius.	*Halecium halecinum* Johnst.	Fabricius.
Manania auricula H. J. C.	Fabricius.	*Bougainvillia superciliaris* Ag.	Mörch.
Lucernaria quadricornis Müll.	Fabricius.	*Coryne mirabilis* Ag.	Sabine.
Haliclystus auricula H. J. C.	Steenstrup.	*Coryne pusilla* Gärt.	Mörch.
Medusa bimorpha Fab.	Fabricius.	*Coryne muscoides* Johnst.	Mörch.
Tiaropsis diademata Ag.	Mörch.	*Candelabrum phrygium* Bl.	Fabricius.
Campanularia volubilis Mörch.	Mörch.	*Tubularia indivisa* Linn.	Mörch.
Campanularia olivacea Lamx.	Mörch.	*Hydractinia polyclina* Ag.	Fabricius.
Eucope diaphana Ag.	Mörch.		

SYSTEMATIC TABLE

OF THE ORDERS AND FAMILIES OF NORTH AMERICAN ACALEPHÆ DESCRIBED IN THIS VOLUME.

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